

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner
 US Department of Commerce
 United States Patent and Trademark
 Office, PCT
 2011 South Clark Place Room
 CP2/5C24
 Arlington, VA 22202
 ETATS-UNIS D'AMERIQUE
 in its capacity as elected Office

Date of mailing (day/month/year) 07 February 2001 (07.02.01)	
International application No. PCT/FI00/00524	Applicant's or agent's file reference OP100020/ANR
International filing date (day/month/year) 09 June 2000 (09.06.00)	Priority date (day/month/year) 11 June 1999 (11.06.99)
Applicant SALMELA, Olli et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:
18 December 2000 (18.12.00)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer R. E. Stoffel Telephone No.: (41-22) 338.83.38
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PCT INTERNATIONAL COOPERATION TREATY

PCT

NOTIFICATION OF THE RECORDING
OF A CHANGE(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

OULUN PATENTTITOIMISTO BERGGREN OY
AB
Teknologiantie 14 D
Fin-90570 Oulu
FINLANDE

Date of mailing (day/month/year) 20 December 2000 (20.12.00)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference OP100020/ANR	
International application No. PCT/FI00/00524	International filing date (day/month/year) 09 June 2000 (09.06.00)

1. The following indications appeared on record concerning:	
<input type="checkbox"/> the applicant	<input type="checkbox"/> the inventor <input checked="" type="checkbox"/> the agent <input type="checkbox"/> the common representative
Name and Address BERGGREN OY AB P.O. Box 16 FIN-00101 Helsinki Finland	State of Nationality
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2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:	
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Name and Address OULUN PATENTTITOIMISTO BERGGREN OY AB Teknologiantie 14 D Fin-90570 Oulu Finland	State of Nationality
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3. Further observations, if necessary:	
4. A copy of this notification has been sent to:	
<input checked="" type="checkbox"/> the receiving Office	<input checked="" type="checkbox"/> the designated Offices concerned
<input checked="" type="checkbox"/> the International Searching Authority	<input type="checkbox"/> the elected Offices concerned
<input type="checkbox"/> the International Preliminary Examining Authority	<input type="checkbox"/> other:

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Maria Victoria CORTIELLO
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PATENT COOPERATION TREATY

PCT

NOTIFICATION OF THE RECORDING
OF A CHANGE(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

OULUN PATENTTITOIMISTO BERGGREN OY
AB
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Fin-90570 Oulu
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Date of mailing (day/month/year) 19 November 2001 (19.11.01)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference OP100020/ANR	
International application No. PCT/FI00/00524	International filing date (day/month/year) 09 June 2000 (09.06.00)

1. The following indications appeared on record concerning:		
<input checked="" type="checkbox"/> the applicant	<input type="checkbox"/> the inventor	<input type="checkbox"/> the agent
<input type="checkbox"/> the common representative		
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	Facsimile No. +358-9-51168080	
	Teleprinter No.	
3. Further observations, if necessary:		
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<input checked="" type="checkbox"/> the receiving Office	<input type="checkbox"/> the designated Offices concerned	
<input type="checkbox"/> the International Searching Authority	<input checked="" type="checkbox"/> the elected Offices concerned	
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The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Athina NICKITAS-ETIENNE
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Published:

- *With international search report.*
- *Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Means for handling high-frequency energy

The present invention relates to structures, by which part of the incoming high-frequency energy can be separated to its own path or energies coming from different paths can be combined to a common path. Means like this are needed in units connected to the base station antennas of mobile networks, for example.

High-frequency dividing means include power dividers and directional couplers. In a power divider, the incoming energy is divided to two or more output paths so that the powers of the branches are usually equally high. A common divider type is the Wilkinson divider, by which the energy can be divided to several output paths as matched and with relatively small losses. The directional coupler has four ports: The energy coming to the input port is mostly directed to a second port, a relatively small part of the incoming energy is directed to the third port, and hardly any energy goes to the fourth port.

In practice, the dividing means are mostly realized by using microstrips. Figure 1 shows an example of such a prior art structure. This is a four-branch Wilkinson divider, which is manufactured in an ordinary circuit board. The circuit board includes a dielectric board 101, on the lower surface thereof a conductor plane 102 connected to the signal ground, and on the upper surface a microstrip 103. The characteristic impedance of the transmission line formed by these parts is Z_0 , which is the same as the impedance of the feed line of the structure. The strip 103 is branched into four microstrips 111, 112, 113 and 114. Their length is $\lambda/4$ at the operating frequency, and each of them forms an impedance $Z_0/\sqrt{4} = Z_0/2$ with the board 101 and the ground plane 102. A discrete resistor 121, the resistance of which is Z_0 , is connected to the second end of the microstrip 111. Correspondingly, similar resistors 122, 123 and 124 are connected to the second ends of the strips 112, 113 and 114, respectively. The second ends of the resistors are connected together with a conductor 105, which consists of three jumper wires. If a multilayer board were used, a strip inside the board 101 would correspond to the conductor 105. The microstrip 111 continues from the connecting point of the resistor 121 onward as a narrower microstrip 131, which forms an impedance Z_0 with the board 101 and the ground plane 102. The microstrip 131 leads to the first output out1. The strips 112, 113 and 114 continue in the same way. They lead to the outputs out2, out3 and out4. The structure has the drawback that the connecting of the discrete components requires joints on the board, which means reduced reliability.

A structure corresponding to that shown in Fig. 1 can also be implemented by thin-film technology, whereby the resistive components are formed by sputtering, for example. A structure like this has the drawback that its costs, including encapsulation, are relatively high.

5 A simple directional coupler can be made by arranging another conductor in parallel with the signal strip conductor on the surface of a dielectric board, the other side of which acts as the ground plane. This structure has the drawback that its directional properties are relatively poor. A structure with better directional properties is
10 obtained when both strips are arranged inside a dielectric board, both sides of which are ground planes. A tighter electromagnetic coupling compared to both structures is obtained e.g. by the so-called Lange coupler. Fig. 2 shows the Lange coupler in the prior art form. It has three conductor areas on the surface of a dielectric board. The first conductor area comprises a quarter-wave long, strip-like center conductor 201,
15 a first strip extension 202 and a second strip extension 203. The extensions 202 and 203 reach from the opposite ends of the structure to the middle of the center conductor 201. The ends of the extensions are connected with conductor wires 221 and 222 to the midpoint of the center conductor. The second conductor area comprises a quarter-wave long strip conductor 211, which runs beside the center
20 conductor, between it and the first extension 202. The third conductor area comprises a quarter-wave long strip conductor 212, which runs beside the center conductor, between it and the second extension 203. The center conductor 201 remains between the conductor strips 211 and 212. The conductor strips 211 and 212 are connected to each other with conductor wires 223 and 224 at the opposite ends of the structure. The structure is a four-port. Port 1 is linked with the end of the
25 conductor 211, which is not between the extension 202 and the center conductor. Port 2 is linked with the end of the conductor 212, which is not between the extension 203 and the center conductor. Port 3 is linked with the branching point of the center conductor and the extension 203. Port 4 is linked with the branching point of the center conductor and the extension 202. Each port also includes the ground
30 plane, which is not drawn in Fig. 2. The signal is fed to port 1, for example. Then most of the energy fed in comes out from port 2. Part of the incoming energy is transferred to port 3. This part is relatively small. Instead, hardly any energy is transferred to port 4. The drawback of the Lange coupler is the joints required by the jumper wires, which mean reduced reliability and an increase in manufacturing
35 costs. In addition, the surface area required is relatively large, because the conductor strips are placed on the same level.

The purpose of the invention is to reduce the above mentioned drawbacks of the prior art. The means according to the invention is characterized in what is set forth in the independent claim. Some preferred embodiments of the invention are presented in the dependent claims.

- 5 The basic idea of the invention is the following: All parts of the dividing means are integrated into a monolithic structure in an insulating material, preferably multilayer ceramics. The transmission line strips and other conductors are formed by printing conductive material on the outer surface of the ceramic piece and in its interlayers, when required. The conductors between the surfaces are formed by filling the hole
10 made through the layer or layers with conducting material. The resistive components parallel with and between the surfaces are formed in a similar manner.

The invention has the advantage that the dividing means becomes reliable. Another advantage of the invention is the fact that the manufacturing costs of the dividing means are relatively low. Both of these advantages are due to the monolithic
15 structure, in which no wire joints are needed. Yet another advantage of the invention is the fact that the structure according to it can be fitted in a relatively small space, because structural parts can be placed on top of each other in the insulating material, and also vertically inside the board. Furthermore, the invention has the advantage that the transmission lines, in which the TEM (transversal electromagnetic) wave,
20 which is advantageous for the coupling, propagates, can be manufactured in a relatively simple manner.

In the following, the invention will be described in more detail. Reference will be made to the accompanying drawings, in which

Figure 1 shows an example of a prior art divider,

25 Figure 2 shows an example of a prior art coupler,

Figure 3a shows an example of a divider according to the invention,

Figure 3b shows a cross-section of the structure of Fig. 3a,

Figure 4a shows another example of a divider according to the invention from the top,

30 Figure 4b shows the divider of Fig. 4a from below,

Figure 5 shows an example of a coupler according to the invention,

Figure 6a shows another example of a coupler according to the invention, and

Figure 6b shows the second main part of the coupler shown in Fig. 6a.

Figures 1 and 2 were already described in connection with the description of the prior art.

5 Figures 3a and 3b show an example of a divider according to the invention. It has corresponding structural parts as the structure of Fig. 1, i.e. it is a four-branch Wilkinson divider. In Figure 3a, the divider is drawn in a similar manner as in Fig. 1, and Fig. 3b shows the section A-A at the resistive structural parts 321, 322, 323 and 324. In this case, the dielectric board 301 is ceramic. The essential difference
10 compared to Fig. 1 is the implementation of resistive structural parts included in the divider. According to the section A-A, the resistive structural parts 321, 322, 323 and 324 are composed of resistive masses that solidly fill the holes in the ceramic structure. Such a through hole in the board is called 'via' in this specification. The lower ends of the resistive parts are combined with a conductor 305 on the lower
15 surface of the board 301. The conductor 305, as well as the ground plane insulated from the conductor 305 on the lower surface, and the conductors on the upper surface of the board are formed with the printing technique in this example. In this way, the structure becomes a monolithic piece. Compared to the structure of Fig. 1, reliability increases and manufacturing costs are reduced, because there are no
20 discrete components and jumper wires. In this description and especially in the claims, a monolithic piece means a solid body, in which the removal of a structural part of the body would essentially break this body. For example, an electronic circuit integrated into silicon is a monolithic piece. In contrast, a board on which a discrete component has been glued, or a conductor wire has been soldered or
25 welded, is not a monolithic piece, because a joint like this can be dismantled without breaking the piece and be made again.

Figures 4a and 4b show another example of an implementation according to the invention, corresponding to Fig. 1. Fig. 4a shows the structure from above, and Fig. 4b from below. The difference compared to the implementation of Fig. 3 is the fact
30 that the resistive structural parts of the Wilkinson divider are formed by printing on the lower surface of the ceramic board 401. On the surface of the board there are, according to Fig. 4b, the resistive parts 421, 422, 423 and 424 and a conductor 405, which connects together the ends of these parts. The other ends of the resistive parts, which are upper in the figure, are connected to the ends of the quarter-wave
35 conductors of the divider by a similar "via" technique, by which the resistive parts

are formed in Fig. 3. In figures 4a and 4b, the holes have been filled with conductor material. For example, via 444 is a conductor, which connects the resistive part 424 to the conductor 414 of the transmission line. The ground plane of the transmission lines, which is in the interlayer of the ceramic board, is not shown in figures 4a and 4b.

The dividing means described above was a Wilkinson divider, which distributes high-frequency energy to several transmission paths. It could also be a means used in an inverse manner, a Wilkinson combiner. In addition, the manner of implementation need not be according to Wilkinson in either case.

Figure 5 shows an example of an implementation of the invention corresponding to the Lange coupler shown in Fig. 2. The idea is that the conductor patterns required by the coupler are placed in different layers of the multilayer board to prevent jumper wires. Figure 5 shows a continuous conductor pattern 531, which is situated in a layer of the board, and a continuous conductor pattern 532 situated in lower layer of the board compared to the previous one. When compared to Fig. 2, the conductor pattern 531 replaces the strip conductors 201, 202 and 203 and the conductor wires 221 and 222 with their joints. The conductor pattern 532 again replaces the strip conductors 211 and 212 and the conductor wires 223 and 224 with their joints. Figure 5 shows the corresponding ports 1 to 4 as in Fig. 2. The ground plane, which is needed both above and below the structure shown in the figure, is not shown. The use of two ground planes entails the extra feature that the electromagnetic field created in the lines is of the TEM form, which is advantageous for the efficiency of the directional coupling. The structure described above can be manufactured besides by using a ceramic board and printing technique also by using an ordinary multilayer circuit board, for example.

When the multilayer technique is used in the above described manner, the Lange coupler and the corresponding circuits can be implemented as a monolithic structure without jumper wires. Another advantage of the multilayer technique is the fact that the surface area required by the structure can be reduced as compared to the situation that the whole circuit would be on the same level. This is shown by Figures 6a and 6b. In Fig. 6a, the conductor pattern 631 corresponds to the conductor pattern 531 in Fig. 5, and the conductor pattern 632 corresponds to the conductor pattern 532 in Fig. 5. The difference compared to Fig. 5 is the fact that the conductors of different layers are placed on a narrower area and on top of each other. When the conductors are on top of each other, a tighter coupling can be accomplished between them.

Some solutions according to the invention have been described above. However, the invention is not limited to these solutions only. The energy divider/combiner can be of the T-junction type, for example. The shape and mutual location of two strips, between which there is an electromagnetic coupling, can vary substantially. The structure can be a so-called hybrid, in which case it has a closed circuit composed of quarter-wave long parts. The inventive idea can be applied in many ways within the scope defined by the independent claim.

Claims

1. A means for handling high-frequency energy, which comprises a dielectric board and in it at least two strip conductors, between which there is a coupling, **characterized** in that the handling means forms a monolithic piece.
- 5 2. A handling means according to claim 1, **characterized** in that said dielectric board (301, 401) is ceramic, and said strip conductors (303, 311) have been processed on its surface.
3. A handling means according to Claim 2, which further comprises at least one resistive structural part, **characterized** in that said resistive structural part (321) is
10 formed of material, which fills up the hole arranged in the ceramic piece.
4. A handling means according to Claim 2, which further comprises at least one resistive structural part, **characterized** in that said resistive structural part (421) is formed of material processed on the surface of the ceramic piece.
5. A handling means according to Claim 3 or 4, **characterized** in that it is a
15 Wilkinson divider.
6. A handling means according to Claim 3 or 4, **characterized** in that it is a Wilkinson combiner.
7. A handling means according to Claim 1, in which said dielectric board is a multilayer board, **characterized** in that some of the strip conductors are placed in at
20 least one interlayer.
8. A handling means according to Claim 7, **characterized** in that on two surfaces of said multilayer board there is a conductive plane so that said strip conductors are in the layers between these planes.
9. A handling means according to Claim 8, **characterized** in that at least two
25 strip conductors (631, 632) in different interlayers of the multilayer board are on top of each other for arranging an electromagnetic coupling.
10. A handling means according to Claim 8, **characterized** in that the strip conductors (531, 532) in the two interlayers of the multilayer board form a Lange coupler.

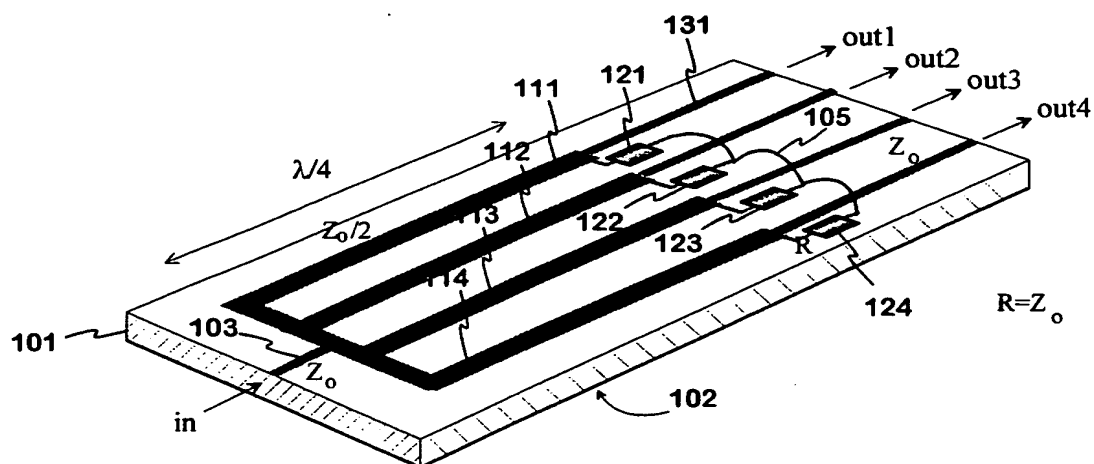


Fig. 1

PRIOR ART

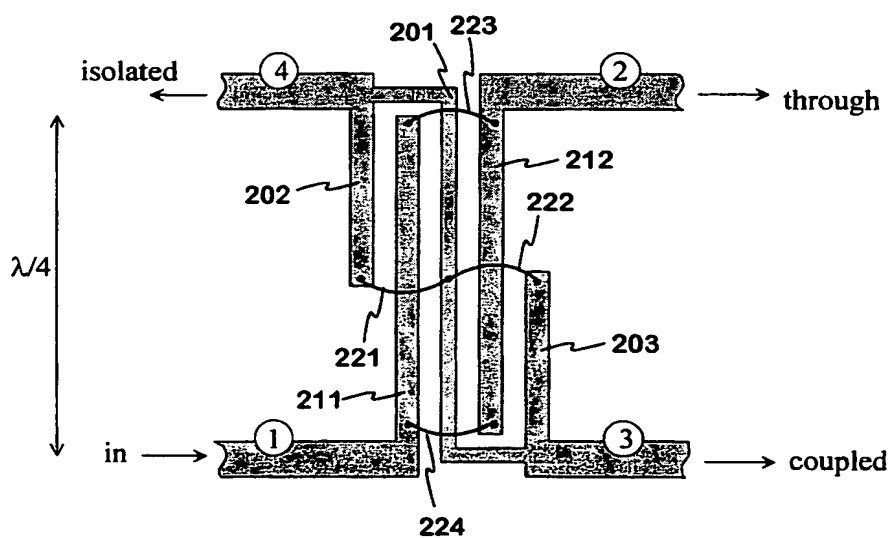


Fig. 2

PRIOR ART

2/3

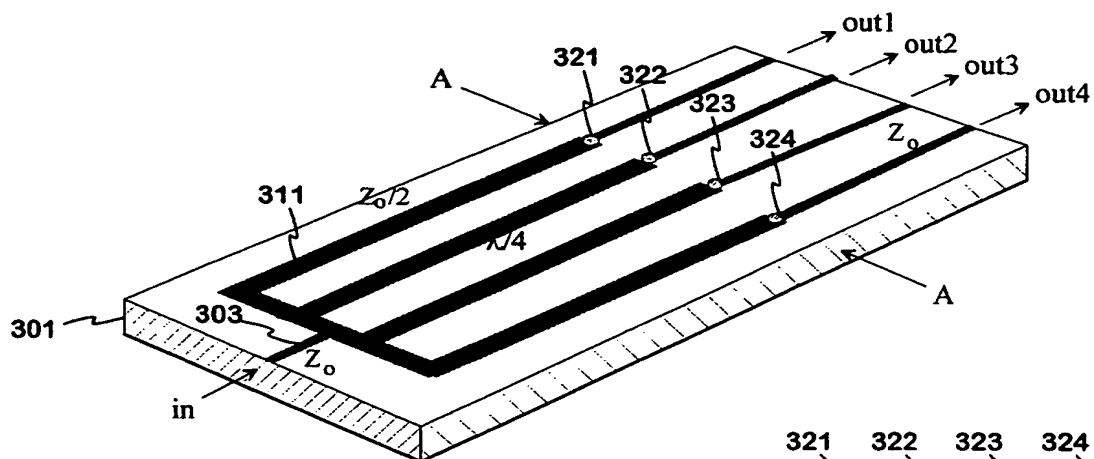


Fig. 3a

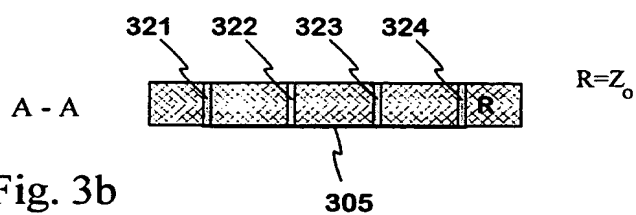


Fig. 3b

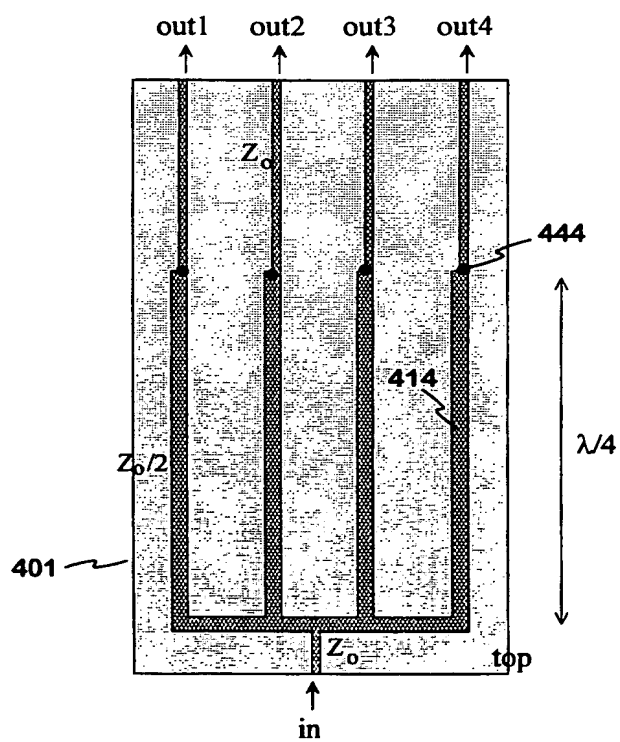


Fig. 4a

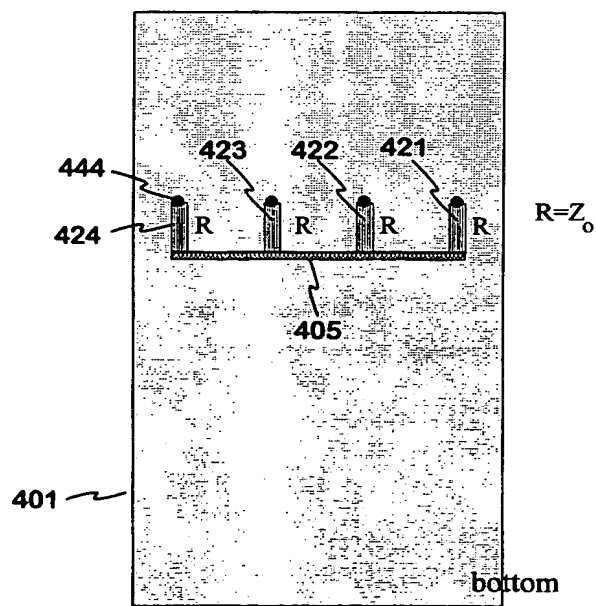


Fig. 4b

3/3

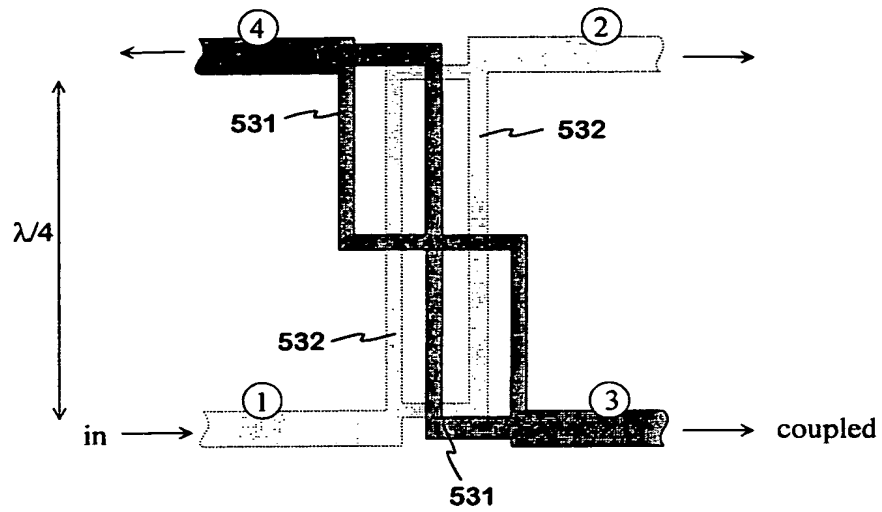


Fig. 5

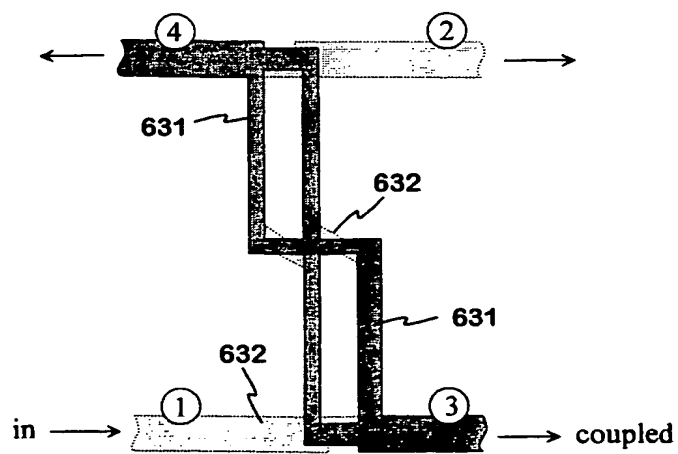


Fig. 6a

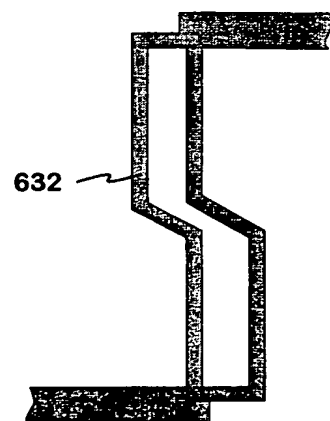


Fig. 6b

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 00/00524

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H01P 5/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H01P

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	1990 IEEE MTT-S, International Microwave Symposium, Volume 2, 1990, T. Tokumitsu et al., "MULTILAYER MMIC USING a 3 μ mX3-LAYER DIELECTRIC FILM STRUCTURE" page 831 - page 834 --	1,2,4-8
X	IEE Tutorial Colloquium on Design of RFIC and MMIC's (1997), Pages 6/1 - 6/7, S.P. Marsh: "MMIC POWER SPLITTING AND COMBINING TECHNIQUES". --	1,2,4-6
X	Patent Abstracts of Japan, abstract of JP 11-136012 A (KYOCERA CORP), 21 May 1999 (21.05.99) --	1,7-10

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

22 Sept 2000

Date of mailing of the international patent search report

09 -10- 2000

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 00/00524

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	IEEE MICROWAVE AND GUIDED WAVE LETTERS, Volume 6, No 10, 1996, K. Nishikawa et al., "Miniaturized Wilkinson Power Divider Using Three-Dimensional MMIC Technology" page 372 - page 374 --	1,2,4-8
A	US 5745017 A (L.E. RALPH), 28 April 1998 (28.04.98), see the whole document -- -----	1,2,4,8,10

INTERNATIONAL SEARCH REPORT

Information on patent family members

01/08/00

International application No.

PCT/FI 00/00524

Patent document cited in search report			Publication date	Patent family member(s)		Publication date
US	5745017	A	28/04/98	US	5534830 A	09/07/96
				US	5640132 A	17/06/97
				US	5640134 A	17/06/97
				US	5640699 A	17/06/97
				AU	4482797 A	14/04/98
				EP	0927434 A	07/07/99
				WO	9812769 A	26/03/98
<hr/>						

Patent- och registreringsverket
P.O. Box 5055
S-102 42 STOCKHOLM
Sweden

30.7.2001
FAX & MAIL (3 pages)

Authorized officer: Bo Gustavsson

Our ref: OP100020/ANR/

INTERNATIONAL PATENT APPLICATION PCT/FI00/00524
APPLICANT: Nokia Networks Oy

Reply to Written Opinion mailed on 31 May 2001
Due date: 30 July 2001

In reply to the first Written Opinion, issued on the above-identified International Patent Application, we herewith submit our comments thereto.

In Written Opinion is claimed the present application, except the matter of claim 3, lacks novelty on grounds of articles D1, D2 and D4, and of publication D3, in accordance with the notes of Written Opinion. The inventiveness of claim 3 is traversed on grounds of publications JP 11068261 and JP 4139896.

The structures in accordance with the references D1-D4 do not comprise resistive structural parts or form a monolithic piece in the sense of the present structure. The JP-publications show resistors in the dielectric board to prevent electric discharge or to let a big current flow.

Because of the references we amend the independent claim 1 by transferring to it part of the subject matter of claim 3.

In Written opinion is claimed the structure showed in D3 is a Lange coupler, which is not true. There is in question an usual directional coupler, which does not show, how the jump wires of a known Lange coupler are avoided. Connecting with above-mentioned amendments, the claim 7 is made in independent form and part of the subject matter of claim 9 is transferred to it.

Furthermore to claim 8 is added the purpose of the arrangement in question. This is mentioned in the description (page 5, lines 21-23).

On above-mentioned grounds we respectfully submit that the claims are patentable.

The pages including the amended claims in English are enclosed.

**OULUN PATENTTITOIMISTO
BERGGREN OY AB**



Antti Räsänen
Patent Attorney

Encls

Claims

1. A means for handling high-frequency energy, which comprises a dielectric board having at least two strip conductors, between which there is a coupling, at least one hole filled with conductive material and at least one resistive structural part, **characterized** in that the handling means form a monolithic piece.
2. A handling means according to claim 1, **characterized** in that said dielectric board (301, 401) is ceramic, and said strip conductors (303, 311) have been processed on its surface.
3. A handling means according to Claim 2, **characterized** in that said resistive structural part (321) is formed of said conductive material filling up a hole in the ceramic board.
4. A handling means according to Claim 2, **characterized** in that said resistive structural part (421) is formed of material processed on the surface of the ceramic board and is in series with said conductive material filling up a hole in the ceramic board.
5. A handling means according to Claim 3 or 4, **characterized** in that it is a Wilkinson divider.
6. A handling means according to Claim 3 or 4, **characterized** in that it is a Wilkinson combiner.
7. A means for handling high-frequency energy, which comprises a multilayer dielectric board having at least two strip conductors, between which there is a electromagnetic coupling, **characterized** in that the handling means forms a monolithic piece, and at least two conductors (531; 631; 532; 632) of said strip conductors are located in different interlayers of the multilayer board on top of each other to arrange said electromagnetic coupling.
8. A handling means according to Claim 7, **characterized** in that on two surfaces of said multilayer board there is a conductive plane so that said strip conductors are in the layers between these planes to form transmission lines suitable for TEM waves.
9. A handling means according to Claim 8, **characterized** in that it is a Lange coupler.

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

Oulun Patenttitoimisto
Berggren OY AB
Teknologiantie 14 D
FIN-90570 Oulu

04.06.2001

PCT

WRITTEN OPINION

(PCT Rule 66)

Applicant's or agent's file reference OP100020/ANR		Date of mailing (day/month/year) 31-05-2001
International application No. PCT/FI00/00524		International filing date (day/month/year) 09.06.2000
International Patent Classification (IPC) or both national classification and IPC H 01 P 5/18		Priority date (day/month/year) 11.06.1999
Applicant Nokia Networks Oy et al		

1. This written opinion is the first (first, etc.) drawn by this International Preliminary Examining Authority.
2. This opinion contains indications relating to the following items:
 - I ☒ Basis of the report
 - II ☐ Priority
 - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
 - IV ☐ Lack of unity of invention
 - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
 - VI ☐ Certain documents cited
 - VII ☐ Certain defects in the international application
 - VIII ☐ Certain observations on the international application
3. The applicant is hereby **invited to reply** to this opinion.

When? See the time limit indicated above. The applicant may, before the expiration of that time limit, request this Authority to grant an extension, see Rule 66.2(d).

How? By submitting a written reply, accompanied, where appropriate, by amendments, according to Rule 66.3. For the form and the language of the amendments, see Rules 66.8 and 66.9.

Also For an additional opportunity to submit amendments, see Rule 66.4.
 For the examiner's obligation to consider amendments and/or arguments, see Rule 66.4bis.
 For an informal communication with the examiner, see Rule 66.6.

If no reply is filed, the international preliminary examination report will be established on the basis of this opinion.
4. The final date by which the international preliminary examination report must be established according to Rule 69.2 is: 11.10.2001

Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. 08-667 72 88	Authorized officer Bo Gustavsson/mj Telephone No. 08-782 25 00
--	--

WRITTEN OPINION

International application No.

PCT/FI00/00524

I. Basis of the opinion

1. With regard to the **elements** of the international application:*

- ☒ the international application as originally filed
- ☐ the description:
 pages _____, as originally filed
 pages _____, filed with the demand
 pages _____, filed with the letter of _____
- ☐ the claims:
 pages _____, as originally filed
 pages _____, as amended (together with any statement) under article 19
 pages _____, filed with the demand
 pages _____, filed with the letter of _____
- ☐ the drawings:
 pages _____, as originally filed
 pages _____, filed with the demand
 pages _____, filed with the letter of _____
- ☐ the sequence listing part of the description:
 pages _____, as originally filed
 pages _____, filed with the demand
 pages _____, filed with the letter of _____

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language English which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☒ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the written opinion was drawn on the basis of the sequence listing:

- ☐ contained in the international application in printed form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheet/fig _____

5. ☐ This opinion has been drawn as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2 (c)).

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this opinion as "originally filed".

WRITTEN OPINION

International application No.

PCT/FI00/00524

V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	<u>3</u>	YES
	Claims	<u>1, 2, 4-10</u>	NO
Inventive step (IS)	Claims		YES
	Claims	<u>1-10</u>	NO
Industrial applicability (IA)	Claims	<u>1-10</u>	YES
	Claims		NO

2. Citations and explanations

The invention relates to means for handling high-frequency energy, in particular to structures for dividing part of the energy into separate paths or combining the energy in plural paths to a common path, e.g. for use in radio communication systems. The aim of the invention is to provide structures that are simple and with reduced losses. This is accomplished by integrating all components of the divider/combiner/coupler into a monolithic structure in an insulating material.

Documents considered to be relevant:

- D1 1990 IEEE MTT-S, International Microwave Symposium, vol. 2, p. 831-834
- D2 IEE Tutorial Colloquium on Design of RFIC and MMIC's, 1997, p. 6/1-6/7
- D3 Patent Abstract of Japan, abstract of JP 11-136012 A
- D4 IEEE Microwave and Guided Wave Letters, vol. 6, no. 10, 1996, p. 372-374

D1-D4 describe monolithic structures for handling high-frequency energy, e.g. microwave dividers and couplers manufactured as integrated structures on a dielectric substrate. As seen from D1 and D4, the structure may comprise multiple layers of passive, interconnected strip components such as transmission lines, inductors, capacitors and/or resistors. Therefore, the invention according to claim 1 lacks novelty.

The invention as described in claim 2 uses a ceramic dielectric board as a substrate instead of a GaAs substrate used in the shown prior-art. However, the use of ceramic substrates for high-frequency monolithic integrated circuits as an alternative to GaAs or glass substrates is well known in the art and has therefore not been taken into consideration. Therefore, the invention according to claim 2 lacks novelty.

.../...

Supplemental Box

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: V.

As already mentioned, the structures shown by at least D1, D2 and D4 comprise passive strip components including resistors processed on or in the substrates. Therefore, the invention according to claim 4 lacks novelty.

As shown in D1-D4, the structures may be designed to function as Wilkinson dividers/combiners or Lange couplers, among others. Therefore, the invention as described in claims 5 and 6 lacks novelty.

The use of multilayer substrates having strip components on an interlayer is shown by D1, D3 and D4. Therefore, the invention according to claim 7 lacks novelty.

D3 describes a Lange coupler in which two strip conductors are processed in different interlayers on top of each other to provide a coupling therebetween. On two surfaces of the multilayer substrate there is a conductive plane so that the strip conductors are in between the conductive planes. Therefore, the invention as described in claims 8, 9 and 10 lacks novelty.

The invention as claimed in claim 3 comprises resistive structures in the multilayer substrate, where the resistors are formed in via holes between the layers. The above cited documents do not show such resistive structures. However, via resistors as such used in multilayer circuit boards are known to the skilled person and described e.g. in the published Japanese patent applications JP 11-68261 A and JP 4-139896 A (copies attached to the Written Opinion). It is considered obvious for the skilled person to use this knowledge when designing a structure according to any of the known devices according to D1-D4. The invention as described in claim 3 therefore lacks inventive step.

The demand must be filed directly with the competent International Preliminary Examining Authority or, if two or more Authorities are competent, with the one chosen by the applicant. The full name or two-letter code of that Authority may be indicated by the applicant on the line below:

IPEA/ SE

PCT

CHAPTER II

DEMAND

under Article 31 of the Patent Cooperation Treaty:
The undersigned requests that the international application specified below be the subject of international preliminary examination according to the Patent Cooperation Treaty and hereby elects all eligible States (except where otherwise indicated).

For International Preliminary Examining Authority use only

Identification of IPEA		Date of receipt of DEMAND
Box No. I IDENTIFICATION OF THE INTERNATIONAL APPLICATION		Applicant's or agent's file reference OP100020/ANR
International application No. PCT/FI00/00524	International filing date (day/month/year) 09 June 2000 (09.06.2000)	(Earliest) Priority date (day/month/year) 11 June 1999 (11.06.1999)
Title of invention MEANS FOR HANDLING HIGH-FREQUENCY ENERGY		
Box No. II APPLICANT(S)		
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) NOKIA NETWORKS OY et al P.O. Box 300 FIN-00045 Nokia Group Finland		Telephone No.: +358-9-51121 Facsimile No.: +358-9-51168080 Teleprinter No.:
State (that is, country) of nationality: Finland		State (that is, country) of residence: Finland
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) SALMELA, Olli Haahkakuja 1 D FIN-00200 Helsinki Finland		
State (that is, country) of nationality: Finland		State (that is, country) of residence: Finland
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) KEMPPINEN, Esa Vernonrinne 17 FIN-00370 Helsinki Finland		
State (that is, country) of nationality: Finland		State (that is, country) of residence: Finland

☒ Further applicants are indicated on a continuation sheet.

Continuation of Box No. II APPLICANT(S)

If none of the following sub-boxes is used, this sheet should not be included in the demand

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

KOIVISTO, Markku
Niittykatu 3 C
FIN-02200 Espoo
Finland

State (that is, country) of nationality:

Finland

State (that is, country) of residence:

Finland

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

SOMERMA, Hans
Mäkeläntie 1
FIN-02880 Veikkola
Finland

State (that is, country) of nationality:

Finland

State (that is, country) of residence:

Finland

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

IKÄLÄINEN, Pertti
Pähkinälehto 27
FIN-03150 Huhmari
Finland

State (that is, country) of nationality:

Finland

State (that is, country) of residence:

Finland

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

SAVOLAINEN, Petri
Kotitontuntie 14
FIN-02200 Espoo
Finland

State (that is, country) of nationality:

Finland

State (that is, country) of residence:

Finland

Further applicants are indicated on another continuation sheet.

Box No. III AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCEThe following person is ☒ agent ☐ common representativeand ☒ has been appointed earlier and represents the applicant(s) also for international preliminary examination.☐ is hereby appointed and any earlier appointment of (an) agent(s)/common representative is hereby revoked.☐ is hereby appointed, specifically for the procedure before the International Preliminary Examining Authority, in addition to the agent(s)/common representative appointed earlier.Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*OULUN PATENTTITOIMISTO
BERGGREN OY AB
Teknologiantie 14 D
FIN-90570 Oulu
Finland

Telephone No.:

+358-8-5515670

Facsimile No.:

+358-8-5566701

Teleprinter No.:

☐ Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.**Box No. IV BASIS FOR INTERNATIONAL PRELIMINARY EXAMINATION****Statement concerning amendments: ***

1. The applicant wishes the international preliminary examination to start on the basis of:

☒ the international application as originally filedthe description ☒ as originally filed
☐ as amended under Article 34the claims ☒ as originally filed
☐ as amended under Article 19 (together with any accompanying statement)
☐ as amended under Article 34the drawings ☒ as originally filed
☐ as amended under Article 342. ☐ The applicant wishes any amendment to the claims under Article 19 to be considered as reversed.3. ☐ The applicant wishes the start of the international preliminary examination to be postponed until the expiration of 20 months from the priority date unless the International Preliminary Examining Authority receives a copy of any amendments made under Article 19 or a notice from the applicant that he does not wish to make such amendments (Rule 69.1(d)). *(This check-box may be marked only where the time limit under Article 19 has not yet expired.)*

* Where no check-box is marked, international preliminary examination will start on the basis of the international application as originally filed or, where a copy of amendments to the claims under Article 19 and/or amendments of the international application under Article 34 are received by the International Preliminary Examining Authority before it has begun to draw up a written opinion or the international preliminary examination report, as so amended.

Language for the purposes of international preliminary examination: English☐ which is the language in which the international application was filed.☒ which is the language of a translation furnished for the purposes of international search.☐ which is the language of publication of the international application.☐ which is the language of the translation (to be) furnished for the purposes of international preliminary examination.**Box No. V ELECTION OF STATES**The applicant hereby elects all eligible States *(that is, all States which have been designated and which are bound by Chapter II of the PCT)*

excluding the following States which the applicant wishes not to elect:

Box No. VI CHECK LIST

The demand is accompanied by the following elements, in the language referred to in Box No. IV, for the purposes of international preliminary examination:

- | | | |
|--|---|--------|
| 1. translation of international application | : | sheets |
| 2. amendments under Article 34 | : | sheets |
| 3. copy (or, where required, translation) of amendments under Article 19 | : | sheets |
| 4. copy (or, where required, translation) of statement under Article 19 | : | sheets |
| 5. letter | : | sheets |
| 6. other (<i>specify</i>) | : | sheets |

For International Preliminary Examining Authority use only

received	not received
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>

The demand is also accompanied by the item(s) marked below:

- | | |
|---|---|
| 1. <input checked="" type="checkbox"/> fee calculation sheet | 4. <input type="checkbox"/> statement explaining lack of signature |
| 2. <input type="checkbox"/> separate signed power of attorney | 5. <input type="checkbox"/> nucleotide and or amino acid sequence listing in computer readable form |
| 3. <input checked="" type="checkbox"/> copy of general power of attorney; reference number, if any: | 6. <input type="checkbox"/> other (<i>specify</i>): letter (copy) sent to WIPO |

Box No. VII SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the demand).

Oulu, 18 December 2000



Antti Räsänen
Patent Attorney
OULUN PATENTTITOIMISTO BERGGREN OY AB

For International Preliminary Examining Authority use only

1. Date of actual receipt of DEMAND:

2. Adjusted date of receipt of demand due to CORRECTIONS under Rule 60.1(b):

3. ☐ The date of receipt of the demand is AFTER the expiration of 19 months from the priority date and item 4 or 5, below, does not apply. ☐ The applicant has been informed accordingly.

4. ☐ The date of receipt of the demand is WITHIN the period of 19 months from the priority date as extended by virtue of Rule 80.5.

5. ☐ Although the date of receipt of the demand is after the expiration of 19 months from the priority date, the delay in arrival is EXCUSED pursuant to Rule 82.

For International Bureau use only

Demand received from IPEA on:

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

PCT

To:

Oulun Patenttitoimisto
Berggren OY AB
Teknologiantie 14 D
FIN-90570 Oulu

RECEIVED
16. 10. 2001
OULUN
PATENTTITOIMISTO

NOTIFICATION OF TRANSMITTAL OF
INTERNATIONAL PRELIMINARY
EXAMINATION REPORT

(PCT Rule 71.1)

Date of mailing
(day/month/year) **12-10-2001**

Applicant's or agent's file reference
OP100020/ANR/PJ

IMPORTANT NOTIFICATION

International application No. PCT/FI00/00524	International filing date (day/month/year) 09-06-2000	Priority date (day/month/year) 11-06-1999
--	---	---

Applicant
Nokia Networks Oy
et al

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.
4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/
Patent- och registreringsverket
Box 5055
S-102 42 STOCKHOLM
Facsimile No. 08-667 72 88

Telex
17978
PATOREG-S

Authorized officer

Birgitta Säll

Telephone No. 08-782 25 00

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference OP100020/ANR	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/FI00/00524	International filing date (day/month/year) 09.06.2000	Priority date (day/month/year) 11.06.1999
International Patent Classification (IPC) or national classification and IPC ₇ H 01 P 5/18		
Applicant NOKIA NETWORKS OY et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 5 sheets, including this cover sheet.
- ☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 1 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 18.12.2000	Date of completion of this report 10.10.2001
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. 08-667 72 83	Authorized officer Bo Gustavsson/AE Telephone No. 08-732 25 00

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/FI00/00524

1. Basis of the report

1. With regard to the **elements** of the international application:*

- ☐ the international application as originally filed
- ☒ the description:
pages 1 - 6 , as originally filed
pages _____ , filed with the demand
pages _____ , filed with the letter of _____
- ☒ the claims:
pages _____ , as originally filed
pages _____ , as amended (together with any statement) under article 19
pages _____ , filed with the demand
pages 7 , filed with the letter of 30.07.2001
- ☒ the drawings:
pages 1/3-3/3 , as originally filed
pages _____ , filed with the demand
pages _____ , filed with the letter of _____
- ☐ the sequence listing part of the description:
pages _____ , as originally filed
pages _____ , filed with the demand
pages _____ , filed with the letter of _____

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language _____ which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☒ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheet/fig _____

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2 (c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/FI00/00524

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	<u>3, 8, 9</u>	YES
	Claims	<u>1, 2, 4-7</u>	NO
Inventive step (IS)	Claims		YES
	Claims	<u>1-9</u>	NO
Industrial applicability (IA)	Claims	<u>1-9</u>	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

The invention relates to means for handling high-frequency energy, in particular to structures for dividing part of the energy into separate paths or combining the energy in plural paths to a common path, e.g. for use in radio communication systems. The aim of the invention is to provide structures that are simple and with reduced losses. This is accomplished by integrating all components of the divider/combiner/coupler into a monolithic structure in an insulating material. According to the amended claim 1, the means comprises resistive structural parts and holes filled with conductive material. According to the new independent claim 7, a multilayer dielectric board comprises strip conductors located in different interlayers thereof, on top of each other.

Documents cited in the International Search Report:

- D1 1990 IEEE MTT-S, International Microwave Symposium, vol. 2, p. 831-834
D2 IEE Tutorial Colloquium on Design of RFIC and MMIC's, 1997, p. 6/1-6/7
D3 Patent Abstract of Japan, abstract of JP 11-136012 A
D4 IEEE Microwave and Guided Wave Letters, vol. 6, no. 10, 1996, p. 372-374
D5 US 5745017 A

Documents not included in the International Search Report:

- D6 Abstract of JP 11-68261 A
D7 Abstract of JP 4-139896 A

.../...

Supplemental Box

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: Box V

D1-D4 describe structures for handling high-frequency energy, e.g. microwave dividers and couplers designed as Microwave Monolithic Integrated Circuit (MMIC) structures on a dielectric substrate, while D5 describes a thick film integrated microwave component such as a coupler.

According to D1 and D4, the structure may comprise multiple layers of passive, interconnected strip components such as transmission lines, inductors, capacitors and/or resistors. Via holes filled with conductive material connecting various integrated parts and parts to ground are also provided e.g. in the Wilkinson Divider device shown by D1. Therefore, the invention according to the amended claim 1 lacks novelty.

The invention as described in claim 2 uses a ceramic dielectric board as a substrate instead of a GaAs substrate used in the shown prior-art. However, the use of ceramic substrates for high-frequency monolithic integrated circuits as an alternative to GaAs or glass substrates is well known in the art and has therefore not been taken into consideration. Therefore, the invention according to claim 2 lacks novelty.

The invention as claimed in claim 3 comprises resistive structures in the multilayer substrate, where the resistors are formed in via holes between the layers. The above cited documents D1-D5 do not show such resistive structures. However, via resistors as such used in multilayer circuit boards are known to the skilled person and described e.g. in D6 and D7 (copies attached to communication with the applicant). It is considered obvious for the skilled person to use this knowledge when designing a structure according to any of the known devices according to D1-D4. The invention as described in claim 3 therefore lacks inventive step.

As mentioned, the structures shown by at least D1 comprise passive strip components including resistors processed on the substrates. In the Wilkinson Divider shown in D1, the resistors are connected in series with conductive via holes. Therefore, the invention according to claim 4 lacks novelty.

As shown in D1 (see also D2 and D4), the structures may be designed to function as Wilkinson dividers/combiners, among others. Therefore, the invention as described in claims 5 and 6 lacks novelty.

.../...

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/FI00/00524

Supplemental Box

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: BOX V

From D1, D3 and D4 the use of multilayer substrates having strip components on an interlayer is shown. According to the documents, the strip components are located in different interlayers in the multilayer substrate, on top of each other. Therefore, the invention according to the new claim 7 lacks novelty.

D1 and D3 describe multilayer devices relating to transmission lines, couplers and/or power combiners/divider, while Lange couplers being designed as monolithic structures are shown by D2. In view of these documents is considered to be an obvious step for a person skilled in the art to design a Lange coupler according to the invention as described in claims 8 and 9. The invention therefore lacks inventive step.

Claims

1. A means for handling high-frequency energy, which comprises a dielectric board having at least two strip conductors, between which there is a coupling, at least one hole filled with conductive material and at least one resistive structural part, **characterized** in that the handling means form a monolithic piece.
5
2. A handling means according to claim 1, **characterized** in that said dielectric board (301, 401) is ceramic, and said strip conductors (303, 311) have been processed on its surface.
3. A handling means according to Claim 2, **characterized** in that said resistive structural part (321) is formed of said conductive material filling up a hole in the ceramic board.
10
4. A handling means according to Claim 2, **characterized** in that said resistive structural part (421) is formed of material processed on the surface of the ceramic board and is in series with said conductive material filling up a hole in the ceramic board.
15
5. A handling means according to Claim 3 or 4, **characterized** in that it is a Wilkinson divider.
6. A handling means according to Claim 3 or 4, **characterized** in that it is a Wilkinson combiner.
7. A means for handling high-frequency energy, which comprises a multilayer dielectric board having at least two strip conductors, between which there is an electromagnetic coupling, **characterized** in that the handling means forms a monolithic piece, and at least two conductors (531; 631; 532; 632) of said strip conductors are located in different interlayers of the multilayer board on top of each other to arrange said electromagnetic coupling.
20
25
8. A handling means according to Claim 7, **characterized** in that on two surfaces of said multilayer board there is a conductive plane so that said strip conductors are in the layers between these planes to form transmission lines suitable for TEM waves.
9. A handling means according to Claim 8, **characterized** in that it is a Lange coupler.

Claims

1. A means for handling high-frequency energy, which comprises a dielectric board and in it at least two strip conductors, between which there is a coupling, **characterized** in that the handling means forms a monolithic piece.
- 5 2. A handling means according to claim 1, **characterized** in that said dielectric board (301, 401) is ceramic, and said strip conductors (303, 311) have been processed on its surface.
3. A handling means according to Claim 2, which further comprises at least one resistive structural part, **characterized** in that said resistive structural part (321) is
10 formed of material, which fills up the hole arranged in the ceramic piece.
4. A handling means according to Claim 2, which further comprises at least one resistive structural part, **characterized** in that said resistive structural part (421) is formed of material processed on the surface of the ceramic piece.
5. A handling means according to Claim 3 or 4, **characterized** in that it is a
15 Wilkinson divider.
6. A handling means according to Claim 3 or 4, **characterized** in that it is a Wilkinson combiner.
7. A handling means according to Claim 1, in which said dielectric board is a multilayer board, **characterized** in that some of the strip conductors are placed in at
20 least one interlayer.
8. A handling means according to Claim 7, **characterized** in that on two surfaces of said multilayer board there is a conductive plane so that said strip conductors are in the layers between these planes.
9. A handling means according to Claim 8, **characterized** in that at least two
25 strip conductors (631, 632) in different interlayers of the multilayer board are on top of each other for arranging an electromagnetic coupling.
10. A handling means according to Claim 8, **characterized** in that the strip conductors (531, 532) in the two interlayers of the multilayer board form a Lange coupler.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 49997	<div style="display: flex; justify-content: space-between;"> <div>FOR FURTHER ACTION</div> <div>see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.</div> </div>	
International application No. PCT/FI 00/00524	International filing date (<i>day/month/year</i>) 9 June 2000	(Earliest) Priority Date (<i>day/month/year</i>) 11 June 1999
Applicant NOKIA NETWORKS OY et al.		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. ☐ Certain claims were found unsearchable (See Box I).

2. ☐ Unity of invention is lacking (See Box II).

3. ☐ The international application contains disclosure of a nucleotide and/or amino acid sequence listing and the international search was carried out on the basis of the sequence listing

☐ filed with the international application.
☐ furnished by the applicant separately from the international application,

☐ but not accompanied by a statement to the effect that it did not include matter going beyond the disclosure in the international application as filed.

☐ transcribed by this Authority.

4. With regard to the title, ☒ the text is approved as submitted by the applicant.
☐ the text has been established by this Authority to read as follows:

5. With regard to the abstract,

☒ the text is approved as submitted by the applicant.
☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is:

Figure No. 3a,b

☒ as suggested by the applicant.

☐ None of the figures.

☐ because the applicant failed to suggest a figure.
☐ because this figure better characterizes the invention.

1
INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 00/00524

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H01P 5/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H01P

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	1990 IEEE MTT-S, International Microwave Symposium, Volume 2, 1990, T. Tokumitsu et al., "MULTILAYER MMIC USING a 3 μ mX3-LAYER DIELECTRIC FILM STRUCTURE" page 831 - page 834 --	1,2,4-8
X	IEE Tutorial Colloquium on Design of RFIC and MMIC's (1997), Pages 6/1 - 6/7, S.P. Marsh: "MMIC POWER SPLITTING AND COMBINING TECHNIQUES". --	1,2,4-6
X	Patent Abstracts of Japan, abstract of JP 11-136012 A (KYOCERA CORP), 21 May 1999 (21.05.99) --	1,7-10

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

22 Sept. 2000

Date of mailing of the international search report

09 -10- 2000

Name and mailing address of the ISA/
Swedish Patent Office
Box 5055, S-102 42 STOCKHOLM
Facsimile No. +46 8 666 02 86

Authorized officer

Bo Gustavsson/AE
Telephone No. +46 8 782 25 00

2
INTERNATIONAL SEARCH REPORT

International application No. .

PCT/FI 00/00524

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	IEEE MICROWAVE AND GUIDED WAVE LETTERS, Volume 6, No 10, 1996, K. Nishikawa et al., "Miniaturized Wilkinson Power Divider Using Three-Dimensional MMIC Technology" page 372 - page 374 --	1,2,4-8
A	US 5745017 A (L.E. RALPH), 28 April 1998 (28.04.98), see the whole document -- -----	1,2,4,8,10

INTERNATIONAL SEARCH REPORT

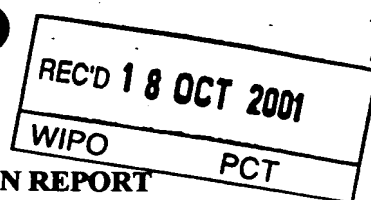
Information on patent family members

01/08/00

International application No.

PCT/FI 00/00524

Patent document cited in search report			Publication date	Patent family member(s)			Publication date
US	5745017	A	28/04/98	US	5534830	A	09/07/96
				US	5640132	A	17/06/97
				US	5640134	A	17/06/97
				US	5640699	A	17/06/97
				AU	4482797	A	14/04/98
				EP	0927434	A	07/07/99
				WO	9812769	A	26/03/98



Applicant's or agent's file reference OP100020/ANR	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/FI00/00524	International filing date (day/month/year) 09.06.2000	Priority date (day/month/year) 11.06.1999
International Patent Classification (IPC) or national classification and IPC ₇ H 01 P 5/18		
Applicant NOKIA NETWORKS OY et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 1 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 18.12.2000	Date of completion of this report 10.10.2001
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. 08-667 72 88	Authorized officer Bo Gustavsson/AE Telephone No. 08-782 25 00

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/FI00/00524

I. Basis of the report**1. With regard to the elements of the international application:***

- ☐ the international application as originally filed
- ☒ the description:
pages 1-6, as originally filed
pages _____, filed with the demand
pages _____, filed with the letter of _____
- ☒ the claims:
pages _____, as originally filed
pages _____, as amended (together with any statement) under article 19
pages _____, filed with the demand
pages 7, filed with the letter of 30.07.2001
- ☒ the drawings:
pages 1/3-3/3, as originally filed
pages _____, filed with the demand
pages _____, filed with the letter of _____
- ☐ the sequence listing part of the description:
pages _____, as originally filed
pages _____, filed with the demand
pages _____, filed with the letter of _____

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language _____ which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☒ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheet/fig _____

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2 (c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

** Any replacement sheet containing such amendments must be referred to under item I and annexed to this report.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/FI00/00524

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	<u>3, 8, 9</u>	YES
	Claims	<u>1, 2, 4-7</u>	NO
Inventive step (IS)	Claims	<u></u>	YES
	Claims	<u>1-9</u>	NO
Industrial applicability (IA)	Claims	<u>1-9</u>	YES
	Claims	<u></u>	NO

2. Citations and explanations (Rule 70.7)

The invention relates to means for handling high-frequency energy, in particular to structures for dividing part of the energy into separate paths or combining the energy in plural paths to a common path, e.g. for use in radio communication systems. The aim of the invention is to provide structures that are simple and with reduced losses. This is accomplished by integrating all components of the divider/combiner/coupler into a monolithic structure in an insulating material. According to the amended claim 1, the means comprises resistive structural parts and holes filled with conductive material. According to the new independent claim 7, a multilayer dielectric board comprises strip conductors located in different interlayers thereof, on top of each other.

Documents cited in the International Search Report:

- D1 1990 IEEE MTT-S, International Microwave Symposium, vol. 2, p. 831-834
- D2 IEE Tutorial Colloquium on Design of RFIC and MMIC's, 1997, p. 6/1-6/7
- D3 Patent Abstract of Japan, abstract of JP 11-136012 A
- D4 IEEE Microwave and Guided Wave Letters, vol. 6, no. 10, 1996, p. 372-374
- D5 US 5745017 A

Documents not included in the International Search Report:

- D6 Abstract of JP 11-68261 A
- D7 Abstract of JP 4-139896 A

.../...

Supplemental Box

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: Box V

D1-D4 describe structures for handling high-frequency energy, e.g. microwave dividers and couplers designed as Microwave Monolithic Integrated Circuit (MMIC) structures on a dielectric substrate, while D5 describes a thick film integrated microwave component such as a coupler.

According to D1 and D4, the structure may comprise multiple layers of passive, interconnected strip components such as transmission lines, inductors, capacitors and/or resistors. Via holes filled with conductive material connecting various integrated parts and parts to ground are also provided e.g. in the Wilkinson Divider device shown by D1. Therefore, the invention according to the amended claim 1 lacks novelty.

The invention as described in claim 2 uses a ceramic dielectric board as a substrate instead of a GaAs substrate used in the shown prior-art. However, the use of ceramic substrates for high-frequency monolithic integrated circuits as an alternative to GaAs or glass substrates is well known in the art and has therefore not been taken into consideration. Therefore, the invention according to claim 2 lacks novelty.

The invention as claimed in claim 3 comprises resistive structures in the multilayer substrate, where the resistors are formed in via holes between the layers. The above cited documents D1-D5 do not show such resistive structures. However, via resistors as such used in multilayer circuit boards are known to the skilled person and described e.g. in D6 and D7 (copies attached to communication with the applicant). It is considered obvious for the skilled person to use this knowledge when designing a structure according to any of the known devices according to D1-D4. The invention as described in claim 3 therefore lacks inventive step.

As mentioned, the structures shown by at least D1 comprise passive strip components including resistors processed on the substrates. In the Wilkinson Divider shown in D1, the resistors are connected in series with conductive via holes. Therefore, the invention according to claim 4 lacks novelty.

As shown in D1 (see also D2 and D4), the structures may be designed to function as Wilkinson dividers/combiners, among others. Therefore, the invention as described in claims 5 and 6 lacks novelty.

.../...

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application N .

PCT/FI00/00524

Supplemental Box

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: BOX V

From D1, D3 and D4 the use of multilayer substrates having strip components on an interlayer is shown. According to the documents, the strip components are located in different interlayers in the multilayer substrate, on top of each other. Therefore, the invention according to the new claim 7 lacks novelty.

D1 and D3 describe multilayer devices relating to transmission lines, couplers and/or power combiners/divider, while Lange couplers being designed as monolithic structures are shown by D2. In view of these documents is considered to be an obvious step for a person skilled in the art to design a Lange coupler according to the invention as described in claims 8 and 9. The invention therefore lacks inventive step.

PCT REQUEST

1/5

Original (for SUBMISSION) - printed on 09.06.2000 11:31:34 AM

49997

0	For receiving Office use only	
0-1	International Application No.	
0-2	International Filing Date	
0-3	Name of receiving Office and "PCT International Application"	
0-4	Form - PCT/RO/101 PCT Request	
0-4-1	Prepared using	PCT-EASY Version 2.90 (updated 10.05.2000)
0-5	Petition The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	Receiving Office (specified by the applicant)	National Board of Patents and Registration (Finland) (RO/FI)
0-7	Applicant's or agent's file reference	49997
I	Title of invention	MEANS FOR HANDLING HIGH-FREQUENCY ENERGY
II	Applicant	
II-1	This person is:	applicant only
II-2	Applicant for	all designated States except US
II-4	Name	NOKIA NETWORKS OY
II-5	Address:	P.O. Box 300 FIN-00045 Nokia Group Finland
II-6	State of nationality	FI
II-7	State of residence	FI
II-8	Telephone No.	+358-9-51121
II-9	Facsimile No.	+358-9-51168080
III-1	Applicant and/or inventor	
III-1-1	This person is:	applicant and inventor
III-1-2	Applicant for	US only
III-1-4	Name (LAST, First)	SALMELA, Olli
III-1-5	Address:	Haahkakuja 1 D FIN-00200 Helsinki Finland
III-1-6	State of nationality	FI
III-1-7	State of residence	FI

PCT REQUEST

2/5

Original (for SUBMISSION) - printed on 09.06.2000 11:31:34 AM

49997

III-2	Applicant and/or inventor	
III-2-1	This person is:	applicant and inventor
III-2-2	Applicant for	US only
III-2-4	Name (LAST, First)	KEMPPINEN, Esa
III-2-5	Address:	Vermorrinne 17 FIN-00370 Helsinki Finland
III-2-6	State of nationality	FI
III-2-7	State of residence	FI
III-3	Applicant and/or inventor	
III-3-1	This person is:	applicant and inventor
III-3-2	Applicant for	US only
III-3-4	Name (LAST, First)	KOIVISTO, Markku
III-3-5	Address:	Niittykatu 3 C FIN-02200 Espoo Finland
III-3-6	State of nationality	FI
III-3-7	State of residence	FI
III-4	Applicant and/or inventor	
III-4-1	This person is:	applicant and inventor
III-4-2	Applicant for	US only
III-4-4	Name (LAST, First)	SOMERMA, Hans
III-4-5	Address:	Mäkeläntie 1 FIN-02880 Veikkola Finland
III-4-6	State of nationality	FI
III-4-7	State of residence	FI
III-5	Applicant and/or inventor	
III-5-1	This person is:	applicant and inventor
III-5-2	Applicant for	US only
III-5-4	Name (LAST, First)	IKÄLÄINEN, Pertti
III-5-5	Address:	Pähkinälehto 27 FIN-03150 Huhmari Finland
III-5-6	State of nationality	FI
III-5-7	State of residence	FI
III-6	Applicant and/or inventor	
III-6-1	This person is:	applicant and inventor
III-6-2	Applicant for	US only
III-6-4	Name (LAST, First)	SAVOLAINEN, Petri
III-6-5	Address:	Kotitontuntie 14 FIN-02200 Espoo Finland
III-6-6	State of nationality	FI
III-6-7	State of residence	FI

PCT REQUEST

3/5

Original (for SUBMISSION) - printed on 09.06.2000 11:31:34 AM

49997

IV-1	Agent or common representative; or address for correspondence The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:	agent
IV-1-1	Name	BERGGREN OY AB
IV-1-2	Address:	P.O. Box 16 FIN-00101 Helsinki Finland
IV-1-3	Telephone No.	+358-9-693701
IV-1-4	Facsimile No.	+358-9-6933944
IV-1-5	e-mail	email.box@berggren.fi
V	Designation of States	
V-1	Regional Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	<p>AP: GH GM KE LS MW MZ SD SL SZ TZ UG ZW and any other State which is a Contracting State of the Harare Protocol and of the PCT</p> <p>EA: AM AZ BY KG KZ MD RU TJ TM and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT</p> <p>EP: AT BE CH&LI CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE and any other State which is a Contracting State of the European Patent Convention and of the PCT</p> <p>OA: BF BJ CF CG CI CM GA GN GW ML MR NE SN TD TG and any other State which is a member State of OAPI and a Contracting State of the PCT</p>
V-2	National Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	<p>AE AG AL AM AT AU AZ BA BB BG BR BY CA CH&LI CN CR CU CZ DE DK DM DZ EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ PL PT RO RU SD SE SG SI SK SL TJ TM TR TT TZ UA UG US UZ VN YU ZA ZW</p>

PCT REQUEST

4/5

Original (for SUBMISSION) - printed on 09.06.2000 11:31:34 AM

49997

V-5	Precautionary Designation Statement In addition to the designations made under items V-1, V-2 and V-3, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except any designation(s) of the State(s) indicated under item V-6 below. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit.	
V-6	Exclusion(s) from precautionary designations	NONE
VI-1	Priority claim of earlier national application	
VI-1-1	Filing date	11 June 1999 (11.06.1999)
VI-1-2	Number	991341
VI-1-3	Country	FI
VI-2	Priority document request The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) identified above as item(s):	VI-1
VII-1	International Searching Authority Chosen	Swedish Patent Office (ISA/SE)
VIII	Check list	number of sheets
VIII-1	Request	5
VIII-2	Description	5
VIII-3	Claims	1
VIII-4	Abstract	1
VIII-5	Drawings	3
VIII-7	TOTAL	15
VIII-8	Accompanying items	paper document(s) attached
VIII-10	Fee calculation sheet	✓
VIII-16	PCT-EASY diskette	-
VIII-18	Figure of the drawings which should accompany the abstract	3a, 3b
VIII-19	Language of filing of the international application	Finnish
IX-1	Signature of applicant or agent	
IX-1-1	Name	BERGGREN OY AB
IX-1-2	Name of signatory	Markus Levlin
IX-1-3	Capacity	Patent Agent

PCT REQUEST

5/5

Original (for SUBMISSION) - printed on 09.06.2000 11:31:34 AM

49997

FOR RECEIVING OFFICE USE ONLY

10-1	Date of actual receipt of the purported international application	
10-2	Drawings:	
10-2-1	Received	
10-2-2	Not received	
10-3	Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application	
10-4	Date of timely receipt of the required corrections under PCT Article 11(2)	
10-5	International Searching Authority	ISA/SE
10-6	Transmittal of search copy delayed until search fee is paid	

FOR INTERNATIONAL BUREAU USE ONLY

11-1	Date of receipt of the record copy by the International Bureau	
------	--	--

PATENT COOPERATION TREATY

26.11.2001

PCT

PATENTTITOIMISTO

NOTIFICATION OF THE RECORDING
OF A CHANGE(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

OULUN PATENTTITOIMISTO BERGGREN OY
AB
Teknologiantie 14 D
Fin-90570 Oulu
FINLANDE

Date of mailing (day/month/year) 19 November 2001 (19.11.01)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference OP100020/ANR	
International application No. PCT/FI00/00524	International filing date (day/month/year) 09 June 2000 (09.06.00)

1. The following indications appeared on record concerning:

☒ the applicant ☐ the inventor ☐ the agent ☐ the common representative

Name and Address

NOKIA NETWORKS OY
P.O. Box 300
FIN-00045 Nokia Group
Finland

State of Nationality

FI

State of Residence

FI

Telephone No.

+358-9-51121

Facsimile No.

+358-9-51168080

Teleprinter No.

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☐ the person ☒ the name ☒ the address ☐ the nationality ☐ the residence

Name and Address

NOKIA CORPORATION
Keilalahdentie 4
FIN-02150 Espoo
Finland

State of Nationality

FI

State of Residence

FI

Telephone No.

+358-9-51121

Facsimile No.

+358-9-51168080

Teleprinter No.

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

☒ the receiving Office ☐ the designated Offices concerned
☐ the International Searching Authority ☒ the elected Offices concerned
☒ the International Preliminary Examining Authority ☐ other:
The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

Athina NICKITAS-ETIENNE

Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

WO 00/77880
PCT/FI00/00524

PCT

NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

From the INTERNATIONAL BUREAU

To:

BERGGREN OY AB
P.O. Box 16
FIN-00101 Helsinki
FINLANDE

RECEIVED
23.01.2001
Oulun
PATENTTIKIRJASTO

Berggren Oy Ab
02-01-2001
ML/MM

Date of mailing (day/month/year)
21 December 2000 (21.12.00)

Applicant's or agent's file reference
(49997) OP100020

IMPORTANT NOTICE

International application No.
PCT/FI00/00524

International filing date (day/month/year)
09 June 2000 (09.06.00)

Priority date (day/month/year)
11 June 1999 (11.06.99)

Applicant
NOKIA NETWORKS OY et al

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:
AG,AU,DZ,KP,KR,MZ,US

In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:
AE,AL,AM,AP,AT,AZ,BA,BB,BG,BR,BY,CA,CH,CN,CR,CU,CZ,DE,DK,DM,EA,EE,EP,ES,FI,GB,GD,GE,GH,GM,HR,HU,ID,IL,IN,IS,JP,KE,KG,KZ,LC,LK,LR,LS,LT,LU,LV,MA,MD,MG,MK,MN,MW,MX,NO,NZ,OA,PL,PT,RO,RU,SD,SE,SG,SI,SK,SL,TJ,TM,TR,TT,TZ,UA,UG,UZ,VN,YU,ZA,ZW
The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on 21 December 2000 (21.12.00) under No. WO 00/77880

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, a demand for international preliminary examination must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the national phase, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Authorized officer

J. Zahra

Facsimile No. (41-22) 740.14.35

Telephone No. (41-22) 338.83.38

PATENT COOPERATION TREATY

PCT

NOTIFICATION CONCERNING
SUBMISSION OR TRANSMITTAL
OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

From the INTERNATIONAL BUREAU

To:

BERGGREN OY AB
P.O. Box 16
FIN-00101 Helsinki
FINLANDE*Berggren Oy Ab*

18 -10- 2000

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30.10.2000

OULUN
PATENTTI-
MISTO

Date of mailing (day/month/year) 09 October 2000 (09.10.00)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference 49997 <i>DP100020</i>	
International application No. PCT/FI00/00524	International filing date (day/month/year) 09 June 2000 (09.06.00)
International publication date (day/month/year) Not yet published	Priority date (day/month/year) 11 June 1999 (11.06.99)
Applicant NOKIA NETWORKS OY et al	

- The applicant is hereby notified of the date of receipt (except where the letters "NR" appear in the right-hand column) by the International Bureau of the priority document(s) relating to the earlier application(s) indicated below. Unless otherwise indicated by an asterisk appearing next to a date of receipt, or by the letters "NR", in the right-hand column, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).
- This updates and replaces any previously issued notification concerning submission or transmittal of priority documents.
- An asterisk(*) appearing next to a date of receipt, in the right-hand column, denotes a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b). In such a case, the attention of the applicant is directed to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.
- The letters "NR" appearing in the right-hand column denote a priority document which was not received by the International Bureau or which the applicant did not request the receiving Office to prepare and transmit to the International Bureau, as provided by Rule 17.1(a) or (b), respectively. In such a case, the attention of the applicant is directed to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

<u>Priority date</u>	<u>Priority application No.</u>	<u>Country or regional Office or PCT receiving Office</u>	<u>Date of receipt of priority document</u>
11 June 1999 (11.06.99)	991341	FI	23 Augu 2000 (23.08.00)

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PCT REQUEST

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49997

0	For receiving Office use only	
0-1	International Application No.	PCT/FI 0 0 / 0 0 5 2 4
0-2	International Filing Date	0 9 JUN 2000 (0 9 -06- 2000)
0-3	Name of receiving Office and "PCT International Application"	The Finnish Patent Office PCT International Application
0-4	Form - PCT/RO/101 PCT Request	
0-4-1	Prepared using	PCT-EASY Version 2.90 (updated 10.05.2000)
0-5	Petition The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	Receiving Office (specified by the applicant)	National Board of Patents and Registration (Finland) (RO/FI)
0-7	Applicant's or agent's file reference	49997
I	Title of invention	MEANS FOR HANDLING HIGH-FREQUENCY ENERGY
II	Applicant	
II-1	This person is:	applicant only
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III-1-7	State of residence	FI

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III-4-7	State of residence	FI
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III-5-6	State of nationality	FI
III-5-7	State of residence	FI
III-6	Applicant and/or inventor	
III-6-1	This person is:	applicant and inventor
III-6-2	Applicant for	US only
III-6-4	Name (LAST, First)	SAVOLAINEN, Petri
III-6-5	Address:	Kotitontuntie 14 FIN-02200 Espoo Finland
III-6-6	State of nationality	FI
III-6-7	State of residence	FI

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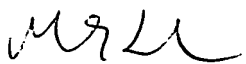
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IV-1	Agent or common representative; or address for correspondence The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:	agent
IV-1-1	Name	BERGGREN OY AB
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IV-1-4	Facsimile No.	+358-9-6933944
IV-1-5	e-mail	email.box@berggren.fi
V	Designation of States	
V-1	Regional Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	<p>AP: GH GM KE LS MW MZ SD SL SZ TZ UG ZW and any other State which is a Contracting State of the Harare Protocol and of the PCT</p> <p>EA: AM AZ BY KG KZ MD RU TJ TM and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT</p> <p>EP: AT BE CH&LI CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE and any other State which is a Contracting State of the European Patent Convention and of the PCT</p> <p>OA: BF BJ CF CG CI CM GA GN GW ML MR NE SN TD TG and any other State which is a member State of OAPI and a Contracting State of the PCT</p>
V-2	National Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	<p>AE AG AL AM AT AU AZ BA BB BG BR BY CA CH&LI CN CR CU CZ DE DK DM DZ EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ PL PT RO RU SD SE SG SI SK SL TJ TM TR TT TZ UA UG US UZ VN YU ZA ZW</p>

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V-5	Precautionary Designation Statement In addition to the designations made under items V-1, V-2 and V-3, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except any designation(s) of the State(s) indicated under item V-6 below. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit.		
V-6	Exclusion(s) from precautionary designations	NONE	
VI-1	Priority claim of earlier national application		
VI-1-1	Filing date	11 June 1999 (11.06.1999)	
VI-1-2	Number	991341	
VI-1-3	Country	FI	
VI-2	Priority document request The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) identified above as item(s):	VI-1	
VII-1	International Searching Authority Chosen	Swedish Patent Office (ISA/SE)	
VIII	Check list	number of sheets	electronic file(s) attached
VIII-1	Request	5	-
VIII-2	Description	5	-
VIII-3	Claims	1	-
VIII-4	Abstract	1	49997.txt
VIII-5	Drawings	3	-
VIII-7	TOTAL	15	
	Accompanying items	paper document(s) attached	electronic file(s) attached
VIII-8	Fee calculation sheet	✓	-
VIII-10	Copy of general power of attorney	✓	-
VIII-16	PCT-EASY diskette	-	diskette
VIII-18	Figure of the drawings which should accompany the abstract	3a, 3b	
VIII-19	Language of filing of the international application	Finnish	
IX-1	Signature of applicant or agent		
IX-1-1	Name	BERGGREN OY AB	
IX-1-2	Name of signatory	Markus Levlin	
IX-1-3	Capacity	Patent Agent	

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10-1	Date of actual receipt of the purported international application	09 JUN 2000 (09-06-2000)
10-2	Drawings:	
10-2-1	Received	
10-2-2	Not received	
10-3	Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application	
10-4	Date of timely receipt of the required corrections under PCT Article 11(2)	
10-5	International Searching Authority	ISA/SE
10-6	Transmittal of search copy delayed until search fee is paid	X

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11-1	Date of receipt of the record copy by the International Bureau	03 JULY 2000 (03.07.00)
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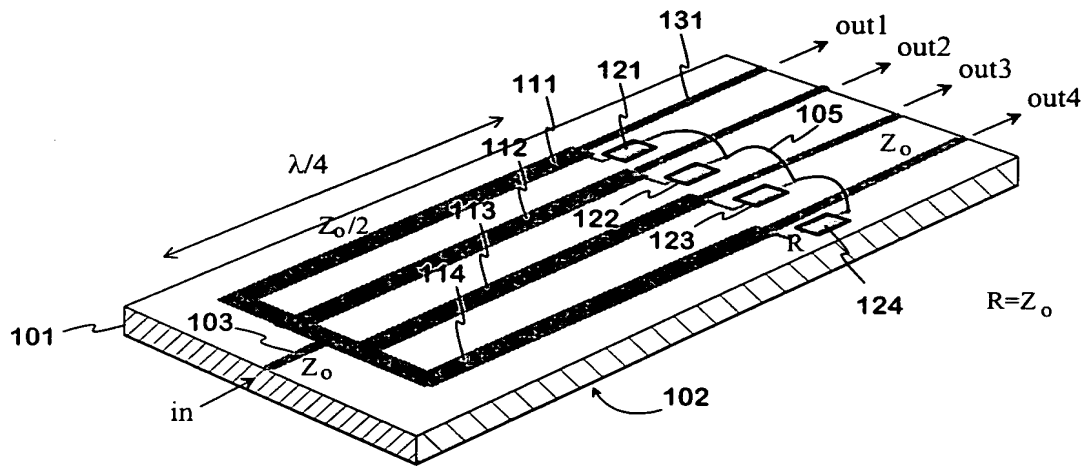


Fig. 1

PRIOR ART

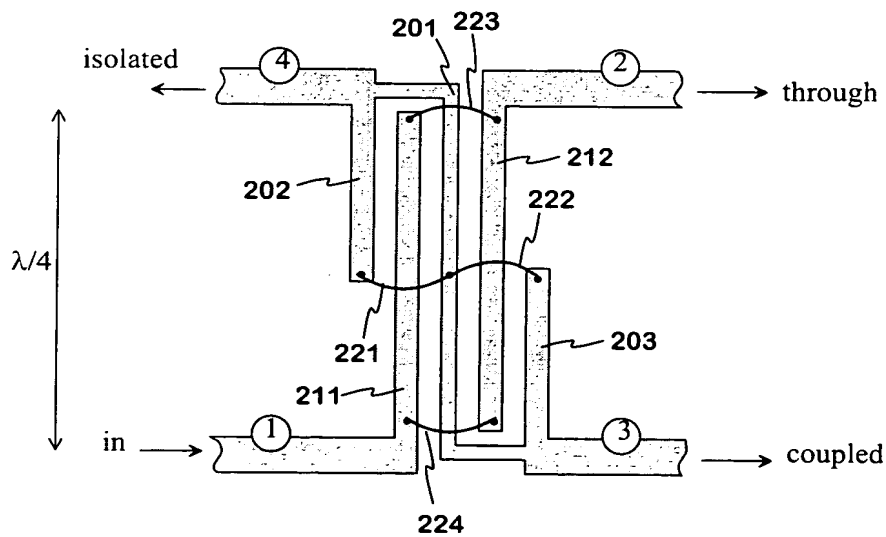


Fig. 2

PRIOR ART

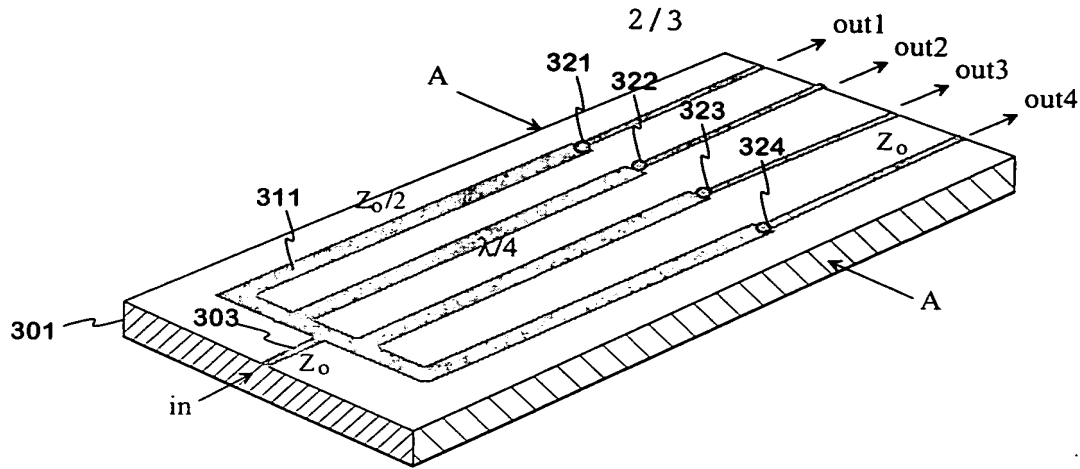


Fig. 3a

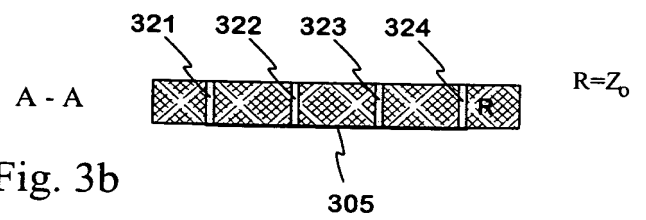


Fig. 3b

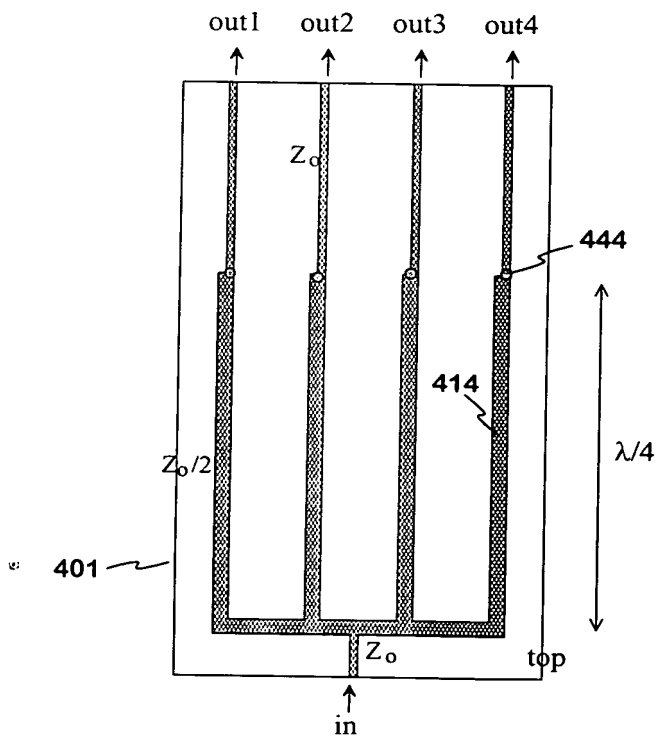


Fig. 4a

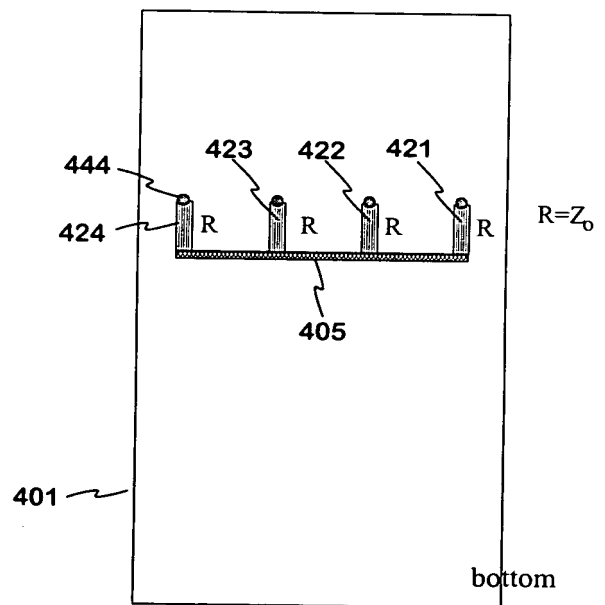


Fig. 4b

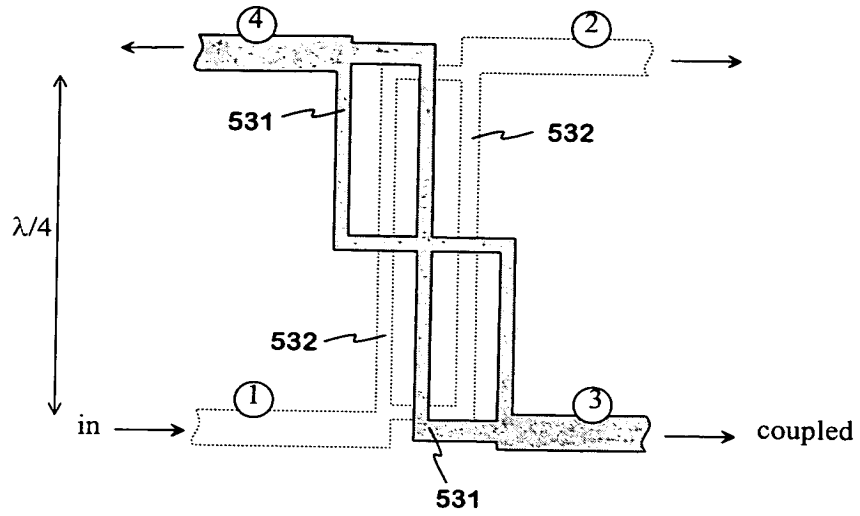


Fig. 5

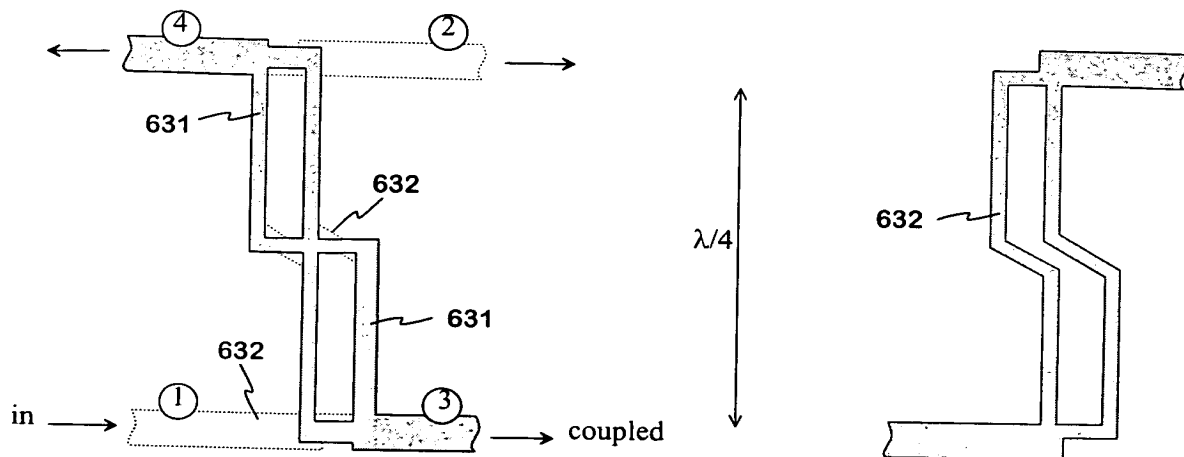


Fig. 6a

Fig. 6b

Suurtaajuksen energian käsittelyelin

5 Keksintö koskee rakenteita, joilla voidaan erottaa osa siihen tulevasta suurtaajukselta energiasta omalle tielle tai yhdistää eri teitä tulevia energioita yhteiselle tielle. Tällaisia elimiä tarvitaan mm. matkaviestinverkkojen tukiasemien antenniin liittyvissä yksiköissä.

10 Suurtaajuisia jakoelimiä ovat mm. tehonjakajat ja suuntakytkimet. Tehonjakajassa ohjautuu tuleva energia kahdelle tai useammalle lähtötielle niin, että haarojen tehot ovat tavallisesti yhtä suuret. Tavallinen jakajatyyppe on ns. Wilkinson-jakaja, jolla energia voidaan jakaa useammalle lähtötielle sovitettuna ja suhteellisen pienin häviöin. Suuntakytkimessä on neljä porttia: Tuloporttiin saapuva energia ohjautuu suurimmaksi osaksi erääseen toiseen porttiin, kolmanteen porttiin ohjautuu tulevasta energiasta suhteellisen pieni osa ja neljanteen porttiin ei mene energiaa juuri lainkaan.

15 Käytännössä jakoelimet toteutetaan useimmiten mikroliuskoja hyväksikäyttäen. Kuvassa 1 on esimerkki tällaisesta ennestään tunnetusta rakenteesta. Kyseessä on nelihaarainen Wilkinson-jakaja, joka on valmistettu tavalliseen piirilevyyn. Piirilevyyn kuuluu dielektrinen levy 101, tämän alapinnalla signaalimaahan kytkettävä johdatus 102 ja yläpinnalla mikroliuska 103. Näiden osien muodostaman siirtojohdon ominaisimpedanssi on Z_0 , joka on sama kuin rakennetta syöttävän johdon impedanssi. Liuska 103 haarautuu neljään mikroliuskaan 111, 112, 113 ja 114. Näiden pituus on toimintataajuudella $\lambda/4$ ja kukin niistä muodostaa levyn 101 ja maatasen 102 kanssa impedanssin $Z_0/\sqrt{4} = Z_0/2$. Mikroliuskan 111 toiseen päähän on kytketty diskreetti vastus 121, jonka resistanssi on Z_0 . Vastaavasti liuskojen 112, 113 ja 114 toisiin päihin on kytketty järjestyksessä samanlaiset vastukset 122, 123 ja 124. Vastusten toiset päät on kytketty yhteen kolmesta hyppylangasta koostuvalla johtimella 105. Monikerroslevyä käytettäessä johdinta 105 vastaisi levyn 101 sisällä oleva liuska. Mikroliuska 111 jatkuu vastuksen 121 kytkentäpisteestä eteenpäin kaapeampana mikroliuskana 131, joka muodostaa levyn 101 ja maatasen 102 kanssa impedanssin Z_0 . Mikroliuska 131 johtaa ensimmäiseen lähtöön out1. Samanlainen jatko on liuskoilla 112, 113 ja 114. Niistä päästään lähtöihin out2, out3 ja out4. Rakenteen haittana on diskreettien komponenttien kytkemisen vaatimat liitokset levyllä, jotka merkitsevät luotettavuuden vähenemistä.

Kuvaa 1 vastaava rakenne voidaan toteuttaa myös ohutkalvotekniikalla, jolloin resistiiviset komponentit muodostetaan esimerkiksi sputteroimalla. Tällaisen rakenteen haittana on sen kotelointineen aiheuttamat suhteellisen suuret kustannukset.

5 Yksinkertainen suuntakytkin saadaan, kun dielektrisen levyn, jonka toinen puoli on maatasona, pinnalla olevan signaaliliuskajohtimen rinnalle järjestetään toinen johdin. Rakenteen haittana on suhteellisen huono suuntaominaisuus. Suuntaominaisuudeltaan parempi rakenne saadaan, kun molemmat liuskat järjestetään dielektrisen levyn sisälle, jonka levyn molemmat puolet ovat maatasoja. Kumpaankin rakenteseen verrattuna tiukempi sähkömagneettinen kytkentä saadaan muun muassa ns. Lange-kytkimellä. Kuva 2 esittää Lange-kytkintä ennestään tunnetussa muodossa. Siinä on dielektrisen levyn pinnalla kolme johdealuetta. Ensimmäiseen johdealueeseen kuuluu neljännesaallon pituinen liuskamainen keskijohdin 201, ensimmäinen liuskauloke 202 ja toinen liuskauloke 203. Ulokkeet 202 ja 203 ulottuvat rakenteen vastakkaisista päistä puoleen väliin keskijohdinta 201. Ulokkeiden päät on yhdistetty lankajohtimilla 221 ja 222 keskijohdinten keskipisteeseen. Toiseen johdealueeseen kuuluu neljännesaallon pituinen liuskajohdin 211, joka on keskijohdinten rinnalla, sen ja ensimmäisen ulokkeen 202 välissä. Kolmanteen johdealueeseen kuuluu neljännesaallon pituinen liuskajohdin 212, joka on keskijohdinten rinnalla, sen ja toisen ulokkeen 203 välissä. Keskijohdin 201 jää johdeliuskojen 211 ja 212 väliin. Johdeliuskat 211 ja 212 on yhdistetty lankajohtimilla 223 ja 224 toisiinsa rakenteen vastakkaisissa päissä. Rakenne on neliportti: Portti 1 liittyy johtimen 211 siihen päähän, joka ei ole ulokkeen 202 ja keskijohdinten välissä. Portti 2 liittyy johtimen 212 siihen päähän, joka ei ole ulokkeen 203 ja keskijohdinten välissä. Portti 3 liittyy keskijohdinten ja ulokkeen 203 haarautumispisteeseen. Portti 4 liittyy keskijohdinten ja ulokkeen 202 haarautumispisteeseen. Kuhunkin porttiin kuuluu toisena osapuolena maataso, jota ei ole piirretty kuvaan 2. Signaali syötetään esimerkiksi porttiin 1. Tällöin suurin osa syötetystä energiasta tulee ulos portista 2. Porttiin 3 kytkeytyy osa tulevasta energiasta. Tämä osa on suhteellisen pieni. Sen sijaan porttiin 4 ei kytkeydy juuri lainkaan energiaa. Lange-kytkimen haittana on hyppylankojen vaatimat liitokset, jotka merkitsevät luotettavuuden pienenemistä ja valmistuskustannusten kasvua. Lisäksi haittana on suhteellisen suuri pinta-alan tarve johdinliuskojen samaan tasoon sijoittelun vuoksi.

Keksinnön tarkoituksena on vähentää mainittuja, tekniikan tasoon liittyviä haittoja. Keksinnön mukaiselle elimelle on tunnusomaista, mitä on esitetty itsenäisessä patenttivaatimuksessa. Keksinnön eräitä edullisia suoritusmuotoja on esitetty epäitsenäisissä patenttivaatimuksissa.

Keksinnön perusajatus on seuraava: Jakoelimen kaikki komponentit integroidaan monoliittiseksi rakenteeksi eristemateriaaliin, edullisesti monikerroskeraamiin. Siirtojohtoliuskat ja muut johtimet muodostetaan painamalla johdemateriaalia keraamikappaleen ulkopinnalle ja tarvittaessa välikerroksiin. Pintojen väliset johtimet muodostetaan täyttämällä kerroksen tai kerrosten läpi tehty reikä johdemateriaalilla. Vastaavilla tavoilla muodostetaan pintojen suuntaiset ja pintojen väliset resistiiviset komponentit.

Keksinnön etuna on, että jakoelimestä tulee luotettava. Lisäksi keksinnön etuna on, että jakoelimen valmistuskustannukset ovat suhteellisen pienet. Nämä molemmat edut ovat seurausta monoliittisesta rakenteesta, jossa ei tarvita lankaliitoksia. Edelleen keksinnön etuna on, että sen mukainen rakenne menee suhteellisen pieneen tilaan, koska rakenneosia voidaan sijoittaa päällekkäin eristemateriaaliin ja toisaalta myös pystysuunnassa levyn sisään. Edelleen keksinnön etuna on, että siirtojohdot, joissa etenee kytkennän kannalta edullinen TEM (transversal electromagnetic) -aalto, ovat suhteellisen yksinkertaisia valmistaa.

Seuraavassa keksintöä selostetaan yksityiskohtaisesti. Selostuksessa viitataan oheisiin piirustuksiin, joissa

- kuva 1 esittää esimerkkiä tekniikan tason mukaisesta jakajasta,
- kuva 2 esittää esimerkkiä tekniikan tason mukaisesta kytkimestä,
- 20 kuva 3a esittää esimerkkiä keksinnön mukaisesta jakajasta,
- kuva 3b esittää poikkileikkausta kuvan 3a rakenteesta,
- kuva 4a esittää toista esimerkkiä keksinnön mukaisesta jakajasta päältäpäin,
- kuva 4b esittää kuvan 4a jakajaa alaspäin,
- kuva 5 esittää esimerkkiä keksinnön mukaisesta kytkimestä,
- 25 kuva 6a esittää toista esimerkkiä keksinnön mukaisesta kytkimestä ja
- kuva 6b esittää kuvan 6a kytkimen toista pääosaa.

Kuvat 1 ja 2 selostettiin jo tekniikan tason kuvauksen yhteydessä.

Kuvissa 3a ja 3b on esimerkki keksinnön mukaisesta jakajasta. Siinä on vastaavat rakenneosat kuin kuvan 1 rakenteessa; ts. kyseessä on siis nelihaarainen Wilkinson-

- 5 jakaja. Kuvassa 3a jakaja on vastaavalla tavalla piirrettynä kuin kuvassa 1, ja kuvassa 3b on leikkauskuva A-A resistiivisten rakenneosien 321, 322, 323 ja 324 kohdalta. Dielektrinen levy 301 on tässä tapauksessa keraaminen. Oleellinen ero kuvaan 1 verrattuna on jakajaan sisältyvien resistiivisten rakenneosien toteutus: Leikkauskuvan A-A mukaisesti resistiiviset rakenneosat 321, 322, 323 ja 324 muodostuvat keraamissa olevat reiät kiinteästi täyttävistä resistiivisistä massoista. Käytetään tällaisesta levyn läpiviennistä termiä ”via”. Resistiivisten osien alapää on yhdistetty levyn 301 alapinnalla olevalla johtimella 305. Johdin 305, samoin kuin alapinnan johtimesta 305 eristetty maataso, sekä levyn yläpinnan johtimet on muodostettu tässä esimerkissä painotekniikalla. Tällä tavalla rakenteesta tulee monoliittinen kappale. Kuvan 1 rakenteeseen verrattuna saavutetaan suurempi luotettavuus ja pienemmät valmistuskustannukset, koska diskreettejä komponentteja ja hyppylankoja ei ole. Monoliittisella kappaleella tarkoitetaan tässä selostuksessa ja erityisesti patenttivaatimuksissa sellaista kiinteästi yhtenäistä kappaletta, jonka jonkin rakenneosan irrottaminen kappaleesta merkitsee tämän olennaista rikkoutumista. Esimerkiksi piihin integroitu elektroniikkapiiri on monoliittinen kappale. Sen sijaan esimerkiksi levy, johon on liimattu diskreetti komponentti, tai juotettu tai hitsattu johdinlanka, ei ole monoliittinen kappale, koska tällainen liitos voidaan purkaa kappaletta rikkomatta ja tehdä uudelleen.
- 20 Kuvisa 4a ja 4b on toinen esimerkki kuvaa 1 vastaavasta, keksinnön mukaisesta toteutuksesta. Kuva 4a esittää rakennetta päältäpäin nähtynä ja kuva 4b alaspäin nähtynä. Erona kuvan 3 mukaiseen toteutukseen on, että Wilkinson-jakajan resistiiviset rakenneosat on muodostettu painamalla keraamilevyn 401 alapinnalle. Levyn pinnassa ovat kuvan 4b mukaisesti mainitut resistiiviset osat 421, 422, 423 ja 424
- 25 sekä näiden toiset päät yhteen kytkevä johdin 405. Resistiivisten osien kuvassa ylemmät päät on kytketty jakajan neljännesaaltojohtojen päihin samanlaisella ”via”-tekniikalla, jolla kuvassa 3 muodostetaan resistiiviset osat. Kuvisa 4a ja 4b reiät on täytetty johdemateriaalilla. Esimerkiksi via 444 on resistiivisen osan 424 siirtojohdon johtimeen 414 yhdistävä johde. Kuvisa 4a ja 4b ei näy siirtojohtojen maatasoa, joka sijaitsee keraamilevyn välikerroksessa.

Edellä on puhuttu suurtaajuista energiaa useammalle siirtotielle hajottavasta Wilkinson-jakajasta. Yhtä hyvin kyseessä voisi olla käänteisesti käytettävä elin, Wilkinson-”combiner” eli -yhdistin. Lisäksi toteutustavan kummassakaan ei luonnollisesti tarvitse olla juuri Wilkinsonin mukainen.

- 35 Kuvisa 5 on esimerkki kuvan 2 Lange-kytkintä vastaavasta, keksinnön mukaisesta toteutuksesta. Ajatuksena on, että kytkimen vaatimat johdekuviot sijoitetaan moni-

kerroslevyn eri kerroksiin hyppylankojen välttämiseksi. Kuvassa 5 on levyn eräässä kerroksessa sijaitseva yhtenäinen johdekuvio 531 ja levyn edelliseen verrattuna alemmassa kerroksessa sijaitseva yhtenäinen johdekuvio 532. Kuvaan 2 verrattaessa johdekuvio 531 korvaa liuskajohtimet 201, 202 ja 203 sekä lankajohtimet 221 ja 222
5 liitoksineen. Johdekuvio 532 taas korvaa liuskajohtimet 211 ja 212 sekä lankajohtimet 223 ja 224 liitoksineen. Kuvaan 5 on merkitty vastaavat portit 1-4 kuin kuvaan 2. Kuvaan ei ole piirretty maatasoa, jollainen tarvitaan kuvassa näkyvän rakenteen sekä ylä- että alapuolelle. Kahden maatasoon käyttöön liittyy se lisäpiirre, että johtoihin syntyvä sähkömagneettinen kenttä on tällöin TEM-muotoa, mikä on suunta-
10 kytkennän tehokkuuden kannalta eduksi. Selostettu rakenne voidaan valmistaa paitsi keraamista levyä ja painotekniikkaa käyttäen myös esimerkiksi tavallista monikerros-
piirilevyä käyttäen.

Edellä kuvatulla tavalla monikerrostekniikkaa käyttämällä Lange-kytkin ja vastaavat piirit voidaan toteuttaa monoliittisena rakenteena ilman johdinlankoja. Toinen etu
15 monikerrostekniikasta on, että rakenteen vaatimaa pinta-alaa voidaan pienentää verrattuna siihen, että koko piiri olisi samassa tasossa. Tätä esittävät kuvat 6a ja 6b. Kuvassa 6a johdekuvio 631 vastaa kuvan 5 johdekuviota 531 ja johdekuvio 632 vastaa kuvan 5 johdekuviota 532. Erona kuvaan 5 verrattuna on, että eri kerrosten johtimet on sijoitettu kapeammalle alueelle ja samalla päällekkäin. Johtimien päällekkäisyydellä saadaan niiden välille tiukempi kytkentä.
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Edellä on kuvattu eräitä keksinnön mukaisia ratkaisuja. Keksintö ei rajoitu juuri niihin. Energian jakaja/yhdistin voi olla esimerkiksi ns. T-liitostyyppiä. Kahden liuskan, joiden välillä on sähkömagneettinen kytkentä, muoto ja keskinäinen sijainti voi vaihdella suuresti. Rakenne voi olla ns. hybridi, jolloin siinä on neljännesaallon
25 pituisista osista muodostuva suljettu piiri. Keksinnöllistä ajatusta voidaan soveltaa lukuisilla tavoilla itsenäisen patenttivaatimuksen asettamissa rajoissa.

Patenttivaatimukset

1. Suurtaajuisen energian käsittelyelin, joka käsittää dielektrisen levyn ja siinä ainakin kaksi liuskajohdinta, joiden välillä on kytkentä, **tunnettu** siitä, että käsittelyelin muodostaa monoliittisen kappaleen.
- 5 2. Patenttivaatimuksen 1 mukainen käsittelyelin, **tunnettu** siitä, että mainittu dielektrinen levy (301, 401) on keraaminen ja mainitut liuskajohtimet (303, 311) on prosessoitu sen pinnalle.
3. Patenttivaatimuksen 2 mukainen käsittelyelin, joka lisäksi käsittää ainakin yhden resistiivisen rakenneosan, **tunnettu** siitä, että mainittu resistiivinen rakenneosa
10 (321) muodostuu keraamiin järjestetyn reiän täyttävästä materiaalista.
4. Patenttivaatimuksen 2 mukainen käsittelyelin, joka lisäksi käsittää ainakin yhden resistiivisen rakenneosan, **tunnettu** siitä, että mainittu resistiivinen rakenneosa (421) muodostuu keraamin pinnalle prosessoidusta materiaalista.
5. Patenttivaatimuksen 3 tai 4 mukainen käsittelyelin, **tunnettu** siitä, että se on
15 Wilkinson-jakaja.
6. Patenttivaatimuksen 3 tai 4 mukainen käsittelyelin, **tunnettu** siitä, että se on Wilkinson-yhdistin.
7. Patenttivaatimuksen 1 mukainen käsittelyelin, jossa mainittu dielektrinen levy on monikerroslevy, **tunnettu** siitä, että mainittuja liuskajohtimia on sijoitettu aina-
20 kin yhteen välikerrokseen.
8. Patenttivaatimuksen 7 mukainen käsittelyelin, **tunnettu** siitä, että mainitun monikerroslevyn kahdella pinnalla on johdetaso siten, että mainitut liuskajohtimet ovat näiden tasojen välissä kerroksissa.
9. Patenttivaatimuksen 8 mukainen käsittelyelin, **tunnettu** siitä, että ainakin kaksi
25 monikerroslevyn eri välikerroksissa olevaa liuskajohdinta (631, 632) on päällekkäin sähkömagneettisen kytkennän järjestämiseksi.
10. Patenttivaatimuksen 8 mukainen käsittelyelin, **tunnettu** siitä, että monikerroslevyn kahdessa välikerroksessa ovat liuskajohtimet (531, 532) muodostavat Lange-kytkimen.

(57) Tiivistelmä

Keksintö koskee rakenteita, joilla voidaan erottaa osa siihen tulevasta suurtaajuudesta energiasta omalle tielleen (out1) tai yhdistää eri teitä tulevia energioita yhteiselle tielle. Keksinnön perusajatus on, että jako- tai yhdistämiselimen kaikki komponentit integroidaan monoliittiseksi rakenteeksi eristemateriaaliin, edullisesti monikerroskeraamiin. Siirtojohtoliuskat (311) ja muut johtimet muodostetaan painamalla johdemateriaalia keraamikappaleen (301) ulkopinnalle ja tarvittaessa välikerrokseen. Pintojen väliset johtimet muodostetaan täyttämällä kerroksen tai kerrosten läpi tehty reikä johdemateriaalilla. Vastaavilla tavoilla muodostetaan pintojen suuntaiset ja pintojen väliset resistiiviset komponentit (321). Keksinnön mukainen rakenne on suhteellisen pienikokoinen, luotettava ja edullinen valmistaa.

Kuviot 3a ja 3b